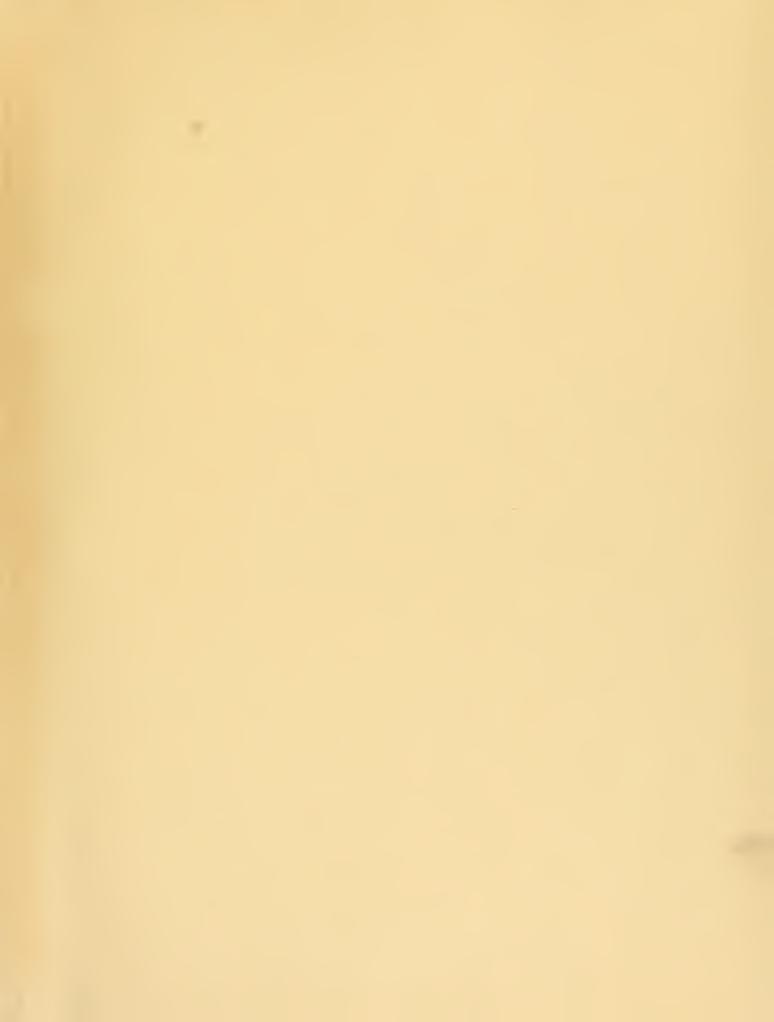
# STRESS CONCENTRATION IN A BEAM WITH A REINFORCED ELLIPTICAL DISCONTINUITY

TERRIL ALEXANDER EFIRD ANDREW HOMER SKINNER, JR. Library
U. 3. Naval Postgraduate School
Annapolis, Md.





Cambridge, Massachusetts May 19, 1950

Professor Joseph S. Newell Secretary of the Faculty Massachusetts Institute of Technology Cambridge, Massachusetts

Dear Sir:

I, Terril A. Efird, in accordance with the requirements for the degree of Naval Engineer, and I, A. Homer Skinner, Jr., in accordance with the requirements for the degree of Master of Science in Naval Architecture, submit herewith a thesis entitled "STRESS CONCENTRATION IN A BEAM WITH A REINFORCED ELLIPTICAL DISCONTINUITY."

Respectfully,



# STRESS CONCENTRATION IN A BEAM WITH A REINFORCED ELLIPTICAL DISCONTINUITY

BY

TERRIL ALEXANDER EFIRD Lieutenant, U. S. Navy B. S. University of California, 1942

ANDREW HOMER STINNER, JR. S. B. Massachusetts
Institute of Technology,
1942

Submitted in Partial Pulfillment of the

Requirements for the Degrees

o.f

HAVAL INGINEER

AMD

MASTER OF SCIENCE IN NAVAL

ARCHITECTURE

Respectively

at the

Massachusetts Institute of Technology

Theses = 26

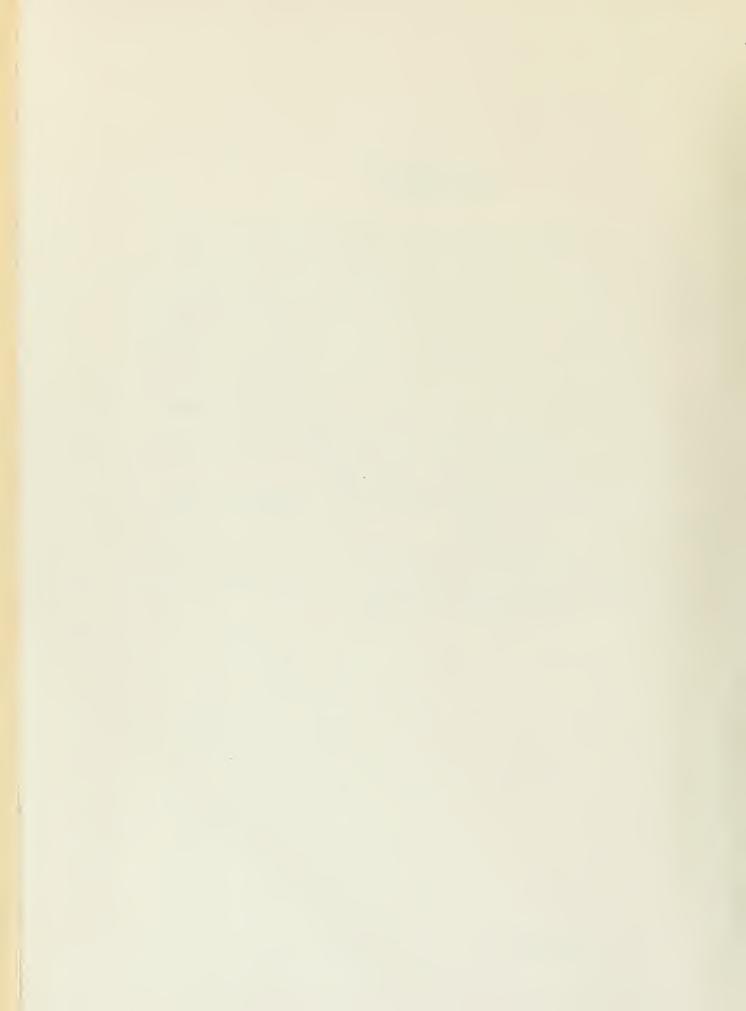
#### ACKNOWLEDGEMENT

The authors wish to express their appreciation for the advice given by Professor C. H. Norris of the Department of Civil Engineering and by Professor W. M. Murray of the Department of Mechanical Engineering in the conduct of the research and in the analysis of the results.

To Mr. W. L. Walsh are due thanks for his invaluable aid in performing the stresscoat tests. Professor W. S. Bailey's instruction and assistance in performing the tensile tests and in the use of the Riehle Testing Machine were greatly appreciated.

To the Boston Naval Shipyard the authors are indebted for the fabrication of the steel model.

The suggestions and criticisms of Professor J. H. Evans were of great help in the preparation of the report.



## TABLE OF CONTENTS

		Page
I	SUMMARY	1
II	INTRODUCTION	3
III	PROCEDURE	13
IV	RESULTS	17
v	DISCUSSION OF RESULTS	31
	Stiffening Ring	32
	Web	34
	Flanges	37
VI	CONCLUSIONS	39
VII	RECOM ENDATIONS	41
VIII	APPENDIX	42
	(A) Details of Procedure	43
	(B) Summary of Data and Calculations	55
	(C) Sample Calculations	77
	(D) Original Data	90
	(E) Bibliography	153

# INDEX OF FIGURES

Figure No.	<u>Title</u>	Page
I	Location of Gages	7
II	Loading Diagram	8
III	Beam Set-up for Pure Bending	9
IV	Close-up of Beam in Pure Bending	10
٧	Pure Bending Set-up Showing Strain Indicator	11
VI	Beam Set-up for Ratio of Stress to Rending Stress Equal to 0.5	12
VII	Variation of Stress Concentration in Stiffening Ring Along Elliptical Arc for Various Breadths of Stiffening Ring Pure Bending	19
VIII	Variation of Stress Concentration in Stiffening Ring Along Elliptical Arc for Various Breadths of Stiffening Ring, $\tau/\sigma = 0.2$	20
IX	Variation of Stress Concentration in Stiffening Ring Along Elliptical Arc for Various Breadths of Stiffening Ring, $\pi/\sigma = 0.35$	21
Х	Variation of Stress Concentration in Stiffening Ring Along Elliptical Arc for Various Breadths of Stiffening Ring, $\tau_0 = 0.50$	22
XI	Maximum Stress Concentration in Stiffening Ring vs. Ratio of Shear Stress to Pending Stress for Various Breadths of Stiffening King	23
XII	Maximum Stress Concentration in Stiffening Ring vs. Breadth of Stiffening Ring for Various Ratios of Shear Stress to Bending Stress	24

XIII	Stress Concentration in Web at the Neutral Axis (Gages 13 and 14) vs. Ratio of Shear Stress to Bending Stress for Various Breadths of Stiffening Ring	25
XIV	Stress Concentration in Web at the Neutral Axis (Gages 13 and 14) vs. Breadths of Stiffening Ring for Various Ratios of Shear Stress to Bending Stress	26
XIV-A	Maximum Observed Stresses in Web, Flange, and Stiffening Ring vs. Breadth of Stiffening Ring for 7/0 = 0.20	27
XIV-B	Maximum Observed Stresses in Web, Flange, and Stiffening Ring vs. Breadth of Stiffening Ring for $\tau/\sigma$ = 0.35	28
XIV-C	Maximum Observed Stresses in Web, Flange, and Stiffening Ring vs. Breadth of Stiffening Ring for 7/0 = 0.50	29
XIV-D	Maximum Observed Stresses in Flange and Stiffening Ring vs. Breadth of Stiffening Ring for Pure Bending	30
XV	Stress Coat Cracks for Pure Bending with $2\frac{1}{2}$ Inch Stiffening Ring	66
XVI	Stress Coat Cracks for 7/0 = 0.2 with 21/2 Inch Stiffening Ring	67
XVII	Stress Coat Cracks for $\sqrt[7]{o} = 0.5$ with $2\frac{1}{2}$ Inch Stiffening Ring	68
XVII	Stress Coat Cracks for $\tau/\sigma$ = 0.5 with 7/16 Inch Stiffening Ring	69
XIX	Interpolation Curves for Web Gages - Stiffening Ring Width = $2\frac{1}{2}$ Inches	70
xx	Interpolation Curves for Web Gages - Stiffening Ring Width = 2 1/8 Inches	71

ΧλΙ	Interpolation Curves for Web Gages - Stiffening Ring Width = 12 Inches	<b>7</b> 2
XXII	Interpolation Curves for Web Gages - Stiffening Ring Width = 3/4 Inch	73
XXIII	Interpolation Curves for Web Gages - Stiffening Ring Width = 7/16 Inch	74
XXIV	Location of Supplementary "A" Gages on Web	75
XXIV-A	Calibration Chart for Determination of Strains Normal to Strains Obtained from Cages 13 and 14	76
XXV	Calibration Chart for Correction of Transverse Bending Effect $\mathcal{T}/\mathcal{O}$ = 0.2	131
XXVI	Calibration Chart for Correction of Transverse Eending Effect $\tau/\sigma = 0.5$	132
XXVII	Load vs. Strain for Gages 1 & 2	133
XXVIII	Load vs. Strain for Gages 3 & 4	134
XXIX	Load vs. Strain for Cages 5 & 6	135
XXX	Load vs. Strain for Gages 7 & 8	136
XXXI	Load vs. Strain for Gages 9 & 10	137
XXXII	Load vs. Strain for Gages 11 % 12	138
XXXIII	Load vs. Strain for Gages 13 & 14	139
VXXXIV	Load vs. Strain for Cages 15, 16, 17, 18, & 19	140
VXXX	Load vs. Strain for Gages 20 & 21	141
XXXVI	Load vs. Strain for Gages 22 & 23	142
XXXVII	Load vs. Strain for Gages 24 & 25	143
XXXVIII	Load vs. Strain for Gages 26 & 27	144
XXXIX	Load vs. Strain for Gages 28 & 29	145

. . .

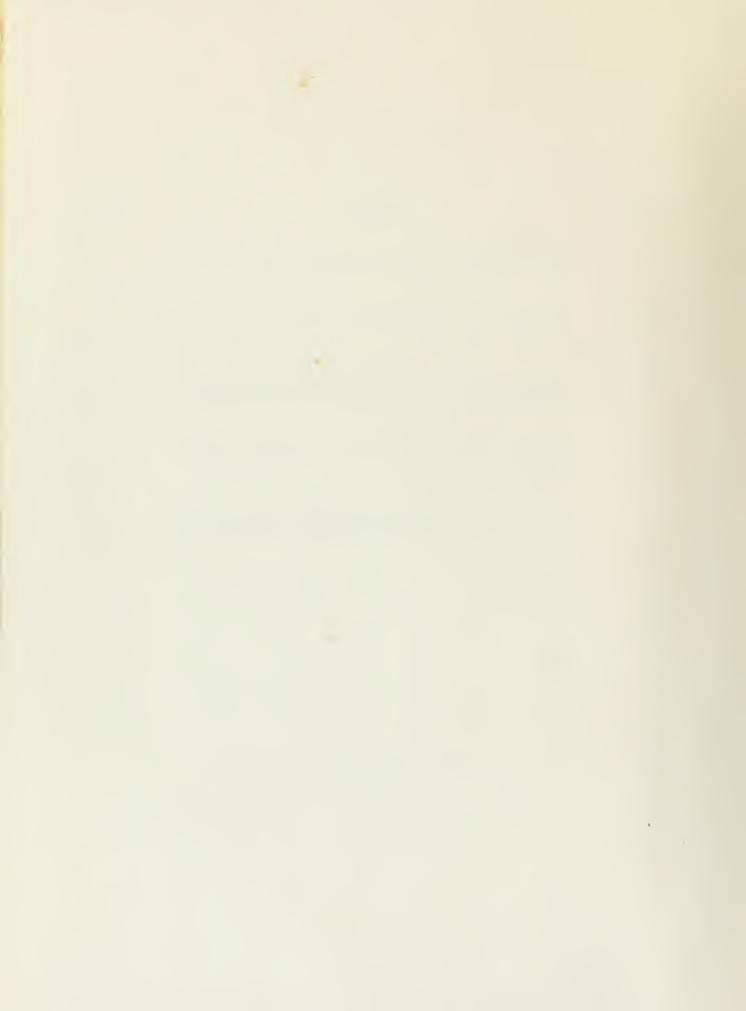


XL	Load vs. Strain for Tensile Test Specimen Cut From Ream Web	148
XLI	Load vs. Strain for Tensile Test Specimen Corresponding to Material used in Stiffening Ring	150
XLII	Wiring Diagram for Strain Gages and Instruments	151
XLIII	Variation of Stress Concentration in Flanges with Distance from Centerline of Ellipse	152
XLIV	Mohr's Circle for Strain	77



### INDEX OF TABLES

Table No.	<u>Title</u>	Page
I	Observed Strains and Stress Concentration Factor for each gage location, Stiffening Ring Breadth 22"	56, 57
II	Observed Strains and Stress Concentration Factor for Each Gage Location, Stiffening King Breadth 2 1/8"	58, 59
III	Observed Strains and Stress Concentration Factor for each Gage Location, Stiffening Ring Breadth	60, 61
IV	Observed Strains and Stress Concentration Factor for each Gage Location Stiffening Ring Breadth 3/4"	62, 63
V	Observed Strains and Stress Concentration Factor for Each Gage Location, Stiffening Ring Breadth 7/16"	54, 65
VI	Original Data - 21 Ring Breadth	91-95
VII	Original Data - 2 1/8" Ring Breadth	99-106
VIII	Original Data - 12 Ring Breadth	107-114
ľx	Original Data - 3/4" Ring Breadth	115-122
X	Original Data - 7/16" Ring Breadth	123-126
XI	Original Data - 7/16" Ring Breadth	127-130
XII	Values of Strains Normal to Strains for Gages 13 and 14 for Various Stiffening Ring Widths	89
XIII	Data from Tensile Test Specimen Cut from Steel Beam	147
XIV	Data from Tensile Test Speciment Cut from Flat Bar	149



#### SUMMARY

This report investigates experimentally the stresses occurring around one quadrant of a centrally-located reinforced elliptical discontinuity in a steel I beam subjected to pure and complex bending. The reinforcement, in the form of a flat bar ring, is varied from an excess breadth to as small a breadth as possible at a constant thickness approximately equal to that of the web. For each reinforcement the beam was tested in pure bending and at three ratios of average shear stress to maximum bending stress at the section of the opening as calculated for the intact beam. The stresses at seventeen selected points in the web, reinforcement and flanges were derived from strains observed from Baldwin SR-4 electrical strain gages in conjunction with "stresscoat" diagrams. Stress concentrations are expressed by the stress concentration factor, defined as the ratio of the observed stress at any point to the calculated principal stress at the point in the intact beam.

The principal results are

- 1. Stress concentrations of considerable magnitude do exist in the reinforcing ring and in the web adjacent to the discontinuity.
- 2. Stress concentration factors in the web at the neutral axis are large and vary directly with breadth of ring and inversely with ratio of shear stress to bending stress.

- 3. Stress concentration factors in the reinforcing ring vary directly with ratio of shear to bending stress and inversely with breadth of ring. They are little affected by breadth of ring below breadths of 7 times the web thickness, where the factor has a value of 1.61, but show a rapid increase as breadth of ring is decreased further.
- 4. For the dimensions of elliptical opening tested (minor axis equal to 0.4 depth of beam, major axis equal to 1.5 minor axis before reinforcement added), stresses in the flanges are little affected by the opening, reinforced or unreinforced.
- 5. The greatest observed value of the stress concentration factor, 3.04, occurred in the web at the neutral axis.
- 6. It was found that increased shear caused a marked increase in the values of the stress concentration factor in the reinforcing ring over those for pure bending, with the result that yielding would take place first in the ring.

The recommendation is made that the breadth of reinforcing rings around elliptical openings in beam webs be made not less than 7 times the thickness of the web, where the ring thickness is the same as that of the web.

#### INTRODUCTION

Discontinuities, either for the purpose of weight reduction or access, occur frequently in such ship structural members as floors, frames, deck beams and longitudinals. In practically every instance the member is loaded as a beam in complex bending, i. e. with the presence of both shear and bending. In the case of longitudinals, axial tensile and compressive forces are also present. It has long been recognized that stress concentrations exist around discontinuities in plates and as a plate is more readily subjected to mathematical analysis, several theoretical solutions have been made. In recent years, various investigators have given thought to the problem of the beam, making use of the analysis of the plate.

That the effect of peripheral reinforcement about a discontinuity was to reduce the stress was shown photoelastically by Ruffner and Schmidt (1) for reinforced and non-reinforced centrally-located web cut-outs in a beam subjected to both shear and bending. Timoshenko (2) made an approximate solution of the stress distribution in a plate with a circular opening, reinforced by a face plate or bead of welding, subjected to uniform tension. He found that the cross section of the bead

<sup>\*</sup>Numbers in parentheses indicate references in the Bibliography.



was the determining factor and that the larger the cross section of the bead, the smaller the stress concentration became. A bead in the form of two angle bars gave the same results as a bead consisting of a flat plate alone.

Sezawa and Kubo (3), conducting their investigations with the use of gelatine models with reinforced circular openings under tension, found that there was a stiffening ring width beyond which, if it were increased, no further reduction in the stress concentration was obtained. Experiments made by Ballinger and Obermeyer (5) of the tensile stress distribution around a reinforced ovaloid opening (consisting of two semicircles joined by a parellel section) indicated the presence of concentrations at the juncture of the circular arcs and the parellel section.

A theoretical solution for an ovaloid opening in the web of a beam subjected to pure bending was obtained by Joseph and Brock (6). Their results are shown by the dashed line in Figure VII.

A theory of notch stress, developed by Neuber (7), gives a solution for a small elliptical hole in a bar subjected to complex bending, the axis of the bar being parallel to the major axis of the ellipse. With an elongated ellipse of small dimensions relative to the width of the bar, he states that the increase of local stress is essentially due to the presence of shear.

Since the majority of previous investigators of this subject have dealt only with the conditions of uniform tension or pure bending, which are only approximations to the actual loading encountered by the structural member in a ship, the subject selected for the present study is a beam having a central elliptical discontinuity of variable reinforcement loaded in complex bending, (Figure I). The elliptical shape was chosen for the purpose of comparing its concentrations with those of the ovaloid. The reinforcement was varied from an excess amount to as small a value as practicable in order to ascertain whether the results of Sezawa and Kubo (3) would hold for complex bending. To indicate the relative degree of shear and bending for any particular condition of loading, the parameter 70, the ratio of the nominal shear stress to the maximum bending stress at the section, is used. T is here defined as the shear at the section divided by the product of the depth of the beam by the thickness of the web. O, represents the bending stress at the extreme fibre. For the calculation of these ratios, the intact beam is used.

The application of the electrical wire strain gages to an eleven foot steel model was deemed the most expedient method of attaining the desired results for this three-dimensional problem. The thickness of the reinforcement was held constant while the breadth was reduced in five successive steps to the least possible amount allowed by the presence of the gages themselves. For all tests the beam was simply supported in



the Richle 100,000 Pound Testing Machine shown in Figures III - VI.

Strain measurements under the loading conditions shown in Figure II

were made on the surface of the stiffening ring, on both sides of the

adjacent web, and on the flanges by gages located as in Figure I. Stress

concentration factors were obtained for each gage location.

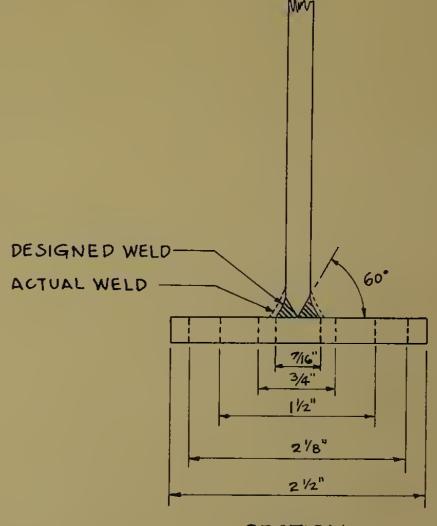
# 6.50" .24" SECTION

6" = 1'-0"

WELD -3.60" -4" REINFORCING RING 4.10" 12" x 6/2" x 25# WF 2.65" 2.234 NOTE: GAGES 21,23,25,27,29 SIMILARLY PLACED ON TOP FLANGE.

## GENERAL NOTES -

- 1. GAGES NOS. 1 THROUGH 14 LIE ON THE SURFACE OF THE WEB, ODD NUMBERS ON ONE SIDE, EVEN NUMBERS ON THE OTHER.
- 2. GAGES NOS. 15 THROUGH 29 LIE IN THE LOCATIONS SHOWN IN THE VERTICAL CENTERLINE PLANE OF THE BEAM.
- 3. ALL GAGES BALDWIN SR-4 TYPE A-8.

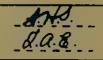


SECTION "A-A"

SHOWING WIPTHS OF REINFORCING RING TESTED

## FIGURE I

# PLATE I

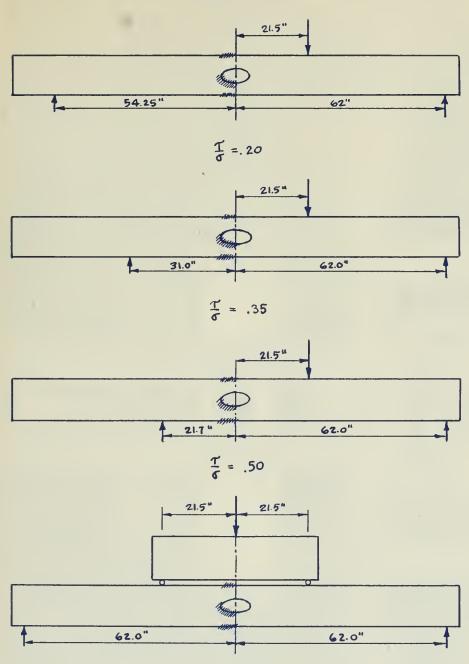


APRIL 24, 1950

LOCATION OF GAGES



Figur e II



PURE BENDING

APRIL 26, 1950 ANS. J.Q.E.

LOADING DIAGRAM

AREA STUDIED SHOWN SHADED

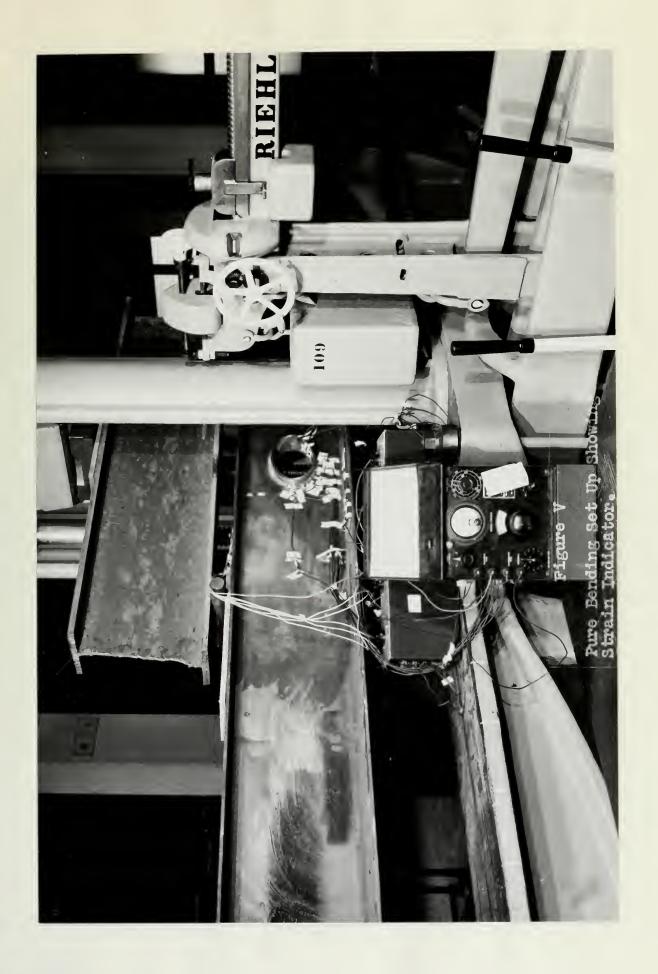




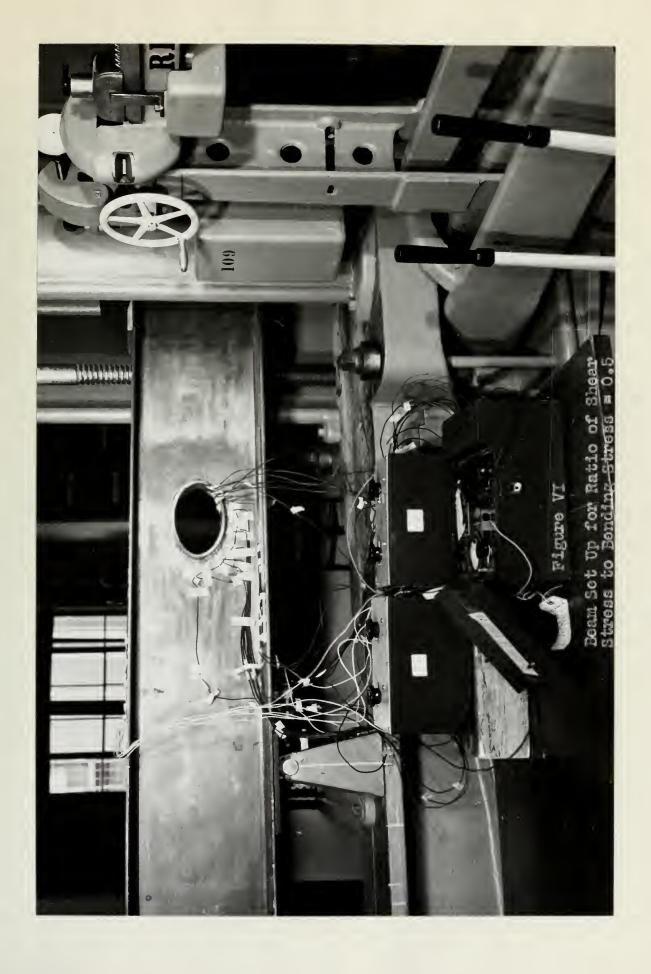














#### PROCEDURE\*

A suitable beam was selected, which, due to its modulus and length and by variation in the location of supports and load, would produce ratios of nominal shear stress to bending stress ( $\frac{7}{6}$ ) between 0.2 and 0.5 at the center of the section to be investigated. Ratios of shear stress to bending stress of 0.2, 0.35, and 0.5, as well as pure bending, were chosen as one of the parameters of the investigation. The second parameter was the variation in width of the flat bar stiffening ring installed as shown in Figure I. Five widths of stiffening ring were tested.

The beam used for the test was a 12" x  $6\frac{1}{2}$ " x 25# wide flange high tensile steel beam eleven feet long. The high tensile steel permitted greater loads to be applied to the beam and consequently produced greater strains, thus tending to reduce errors in strain measurement.

The in x 200 mild steel flat bar stiffening ring was welded into the elliptical hole in which the ratio of depth to length was 1.5. The depth of the hole before installation of the stiffening ring was 0.4 times the depth of the beam. After all welding was completed on the

<sup>\*</sup>Details of procedure are given in Appendix A.



beam, it was stress relieved by being heated up to 1125°F, held at that temperature for 1 hour, and allowed to cool in the furnace.

Standard flat plate tensile specimens were made to determine the modulus of elasticity of the beam and the stiffening ring.

Since the strains induced in the section under investigation were to be measured by Baldwin SR-4 Strain Gages, it was essential to determine their proper location and orientation in order that the most information be obtained with the least number of gages. A series of stress coat tests were performed to gain this information and are recorded in Figures XV through XVII. Stress coat is a brittle coating which cracks along lines normal to the principal tensile strains.

Type A-8 strain gages were used throughout the test because of their small size and short gage length (1/8 inch). This was necessary in order to obtain a number of strain readings in the web adjacent to the stiffening ring where space was limited, and, in the stiffening ring itself.

The strain gages were cemented to the beam and allowed to dry for a week before being used. Gage locations and orientation are shown in Figure I.

The strain gages were connected as shown in Figure XLII with one compensating gage used in conjunction with all the active gages to take account of temperature effects. Switching from one active gage to the other was accomplished by using two Baldwin 20 point switching units. Strains were measured directly in micro-inches per inch with a Baldwin Portable Strain Indicator, Model K.



For each stiffening ring width the beam was loaded successively as shown in Figure II by the Riehle 100,000 pound testing machine pictured in Figures III thru VI. The three tests for ratios of shear stress to bending stress plus the pure bending test gave four points to be used in plotting the results of the tests. For each loading condition, the zero reading was taken for each gage, then the load applied in four increments to the maximum load, and then reduced by the same increments. Strain readings were recorded for each increment of load increasing and decreasing as well as the initial and final zero readings in order to check the reliability of the gages.

The stiffening ring width was reduced by clamping the beam, with the web horizontal, in a shaper, then cutting transversely across the ring from one side to the other. This method proved very effective, since the rate of cutting was slow enough that the heat generated was insufficient to adversely affect the installed strain gages.

The stiffening ring was reduced in successive steps to 7/16" which was as narrow as it could be made without risking damage to gages installed on the stiffening ring and on the web.

After completion of all tests, the web gages were removed and another stress coat test was made for a shear stress to bending stress ratio = 0.5 in order to determine how nearly the strain cracks conformed to those originally obtained with the stiffening ring width 2½ inches. These results are shown in Figure XVIII and are superimposed for comparison on the original data as shown in Figure XV.



The stress concentration factors determined in this experiment are obtained by dividing the experimental value of stress by the calculated principal stress at the same point in the intact beam.

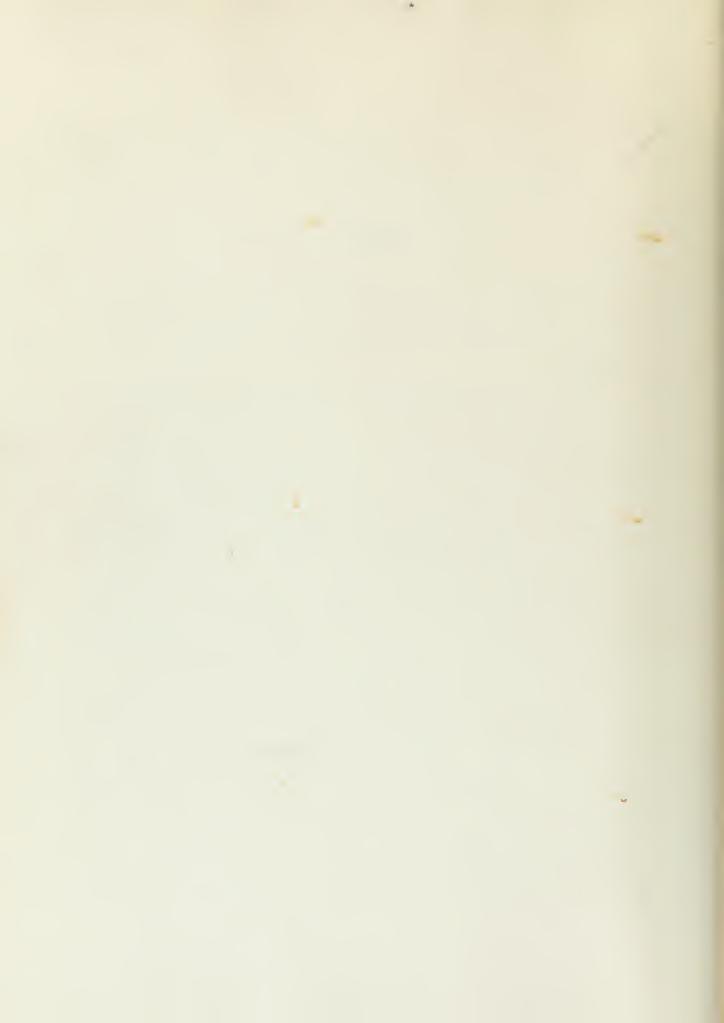


### RESULTS

The results of this investigation are embodied in Tables I-V, inclusive; Figures VII to XIV-D, inclusive; and Figures XV-XVIII, inclusive.

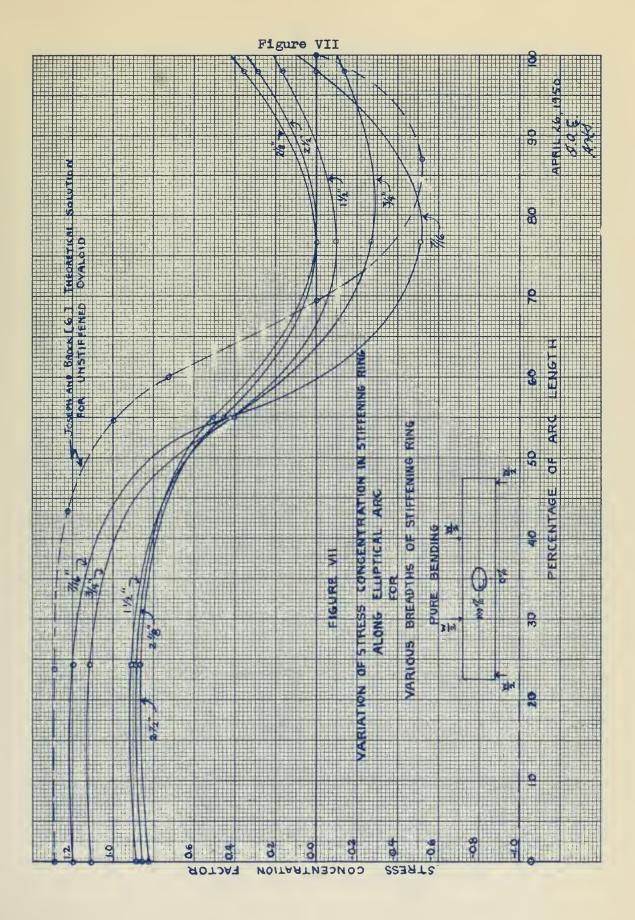
Tables I-V give the value of the principal stress derived from the observed strains for every gage location and each condition of loading. These are compared with the calculated principal stress for the same point by means of the stress concentration factor, which is defined as the ratio of the derived stress for the beam with the reinforced discontinuity to the calculated stress for the intact beam.

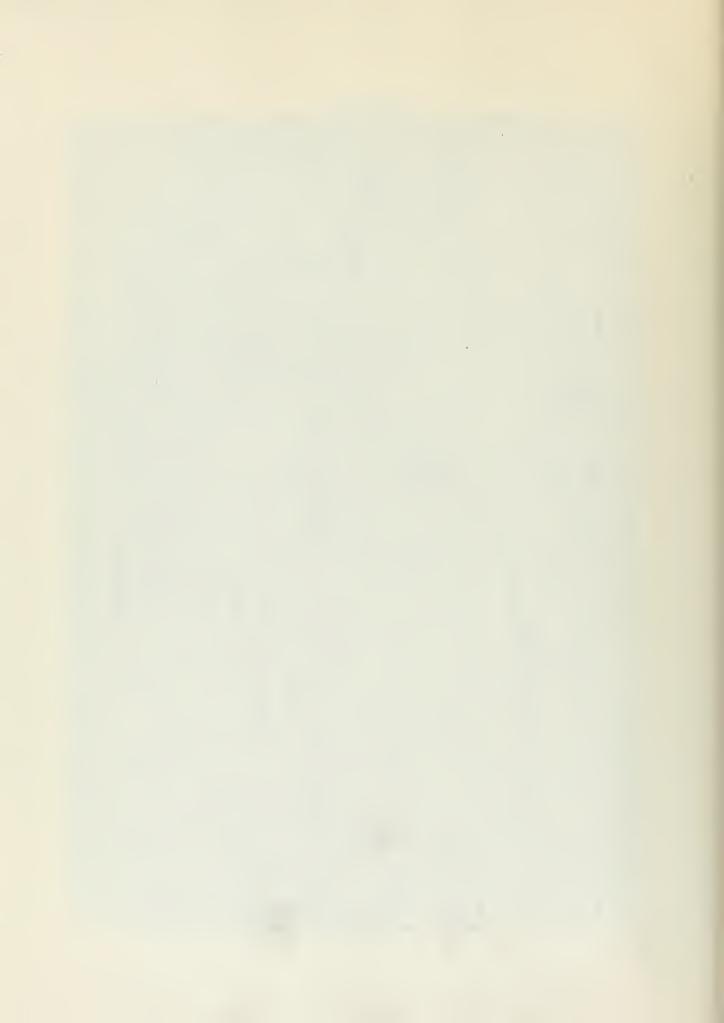
Figures VII to XIV-D are graphical representations of the results incorporated in Tables I-V, and show the variation of stress concentration with the two basic parameters: (1) breadth of stiffening ring, and (2) ratio of the nominal shear stress to the maximum bending stress (%) taken at a section coincident with the vertical centerline if the ellipse, for the intact beam, Nominal shear stress is defined as the shear force at the section divided by the product of the depth of the beam times the thickness of the web. For the stiffening ring, results are first presented, in Figures VIII, IX, and X, by graphs of stress concentration factor as a function of distance along the elliptical arc of the stiffening

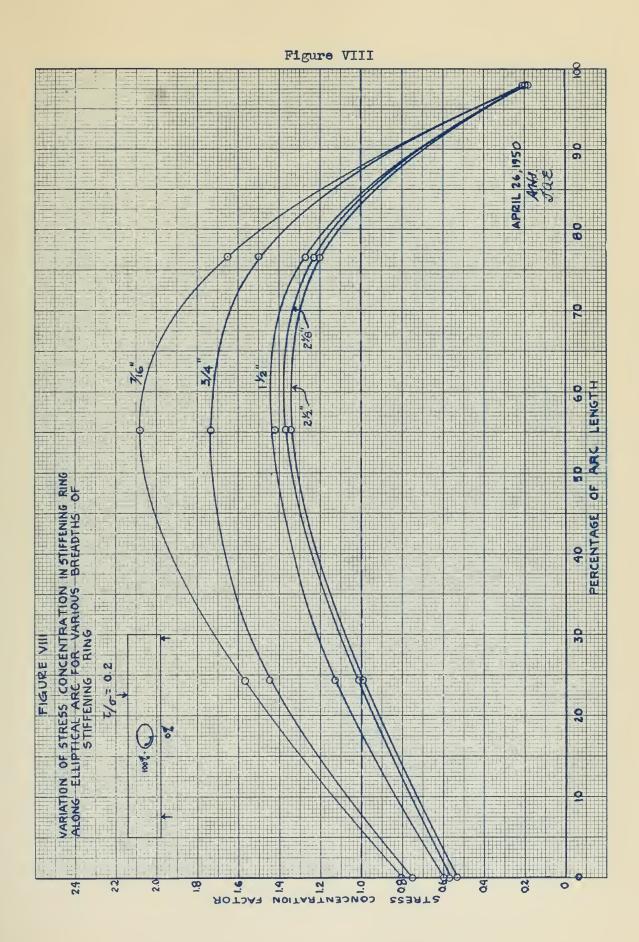


ring surface measured from the vertical centerline. Figures XI and XII, which are the cross curves of Figures VIII, IX, and X, show the variation of the factor with the two basic parameters. For the web, the value of the factor as found in Tables I-V for gages 13 and 14 is plotted against the two basic parameters. These gages were selected because only minor stress concentrations were found to be present at all other web gage locations, except for the smallest breadths of stiffening ring.

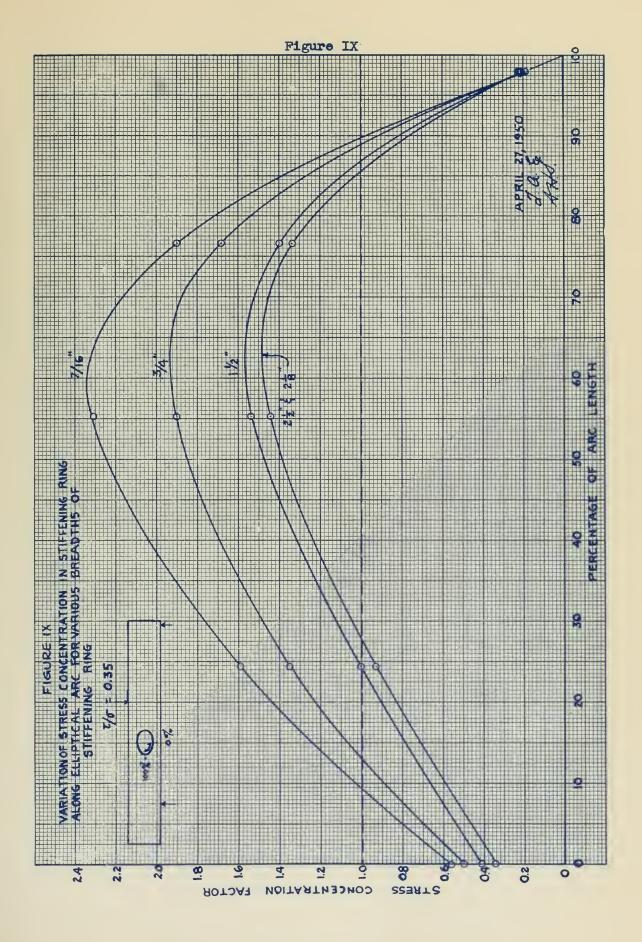
Figures XV, XVI, and XVII, in Appendix D, show the lines of the cracks in the stress coat for load conditions % = 0.20, 0.50, and pure bending. From these diagrams,  $\theta$ , the angle between the axis of the gage and the principal tensile strain (the orthoronal trajectories of the crack lines), was determined. The values of 0 for % = 0.35 were obtained from those for 0.20 and 0.50 by linear interpolation.













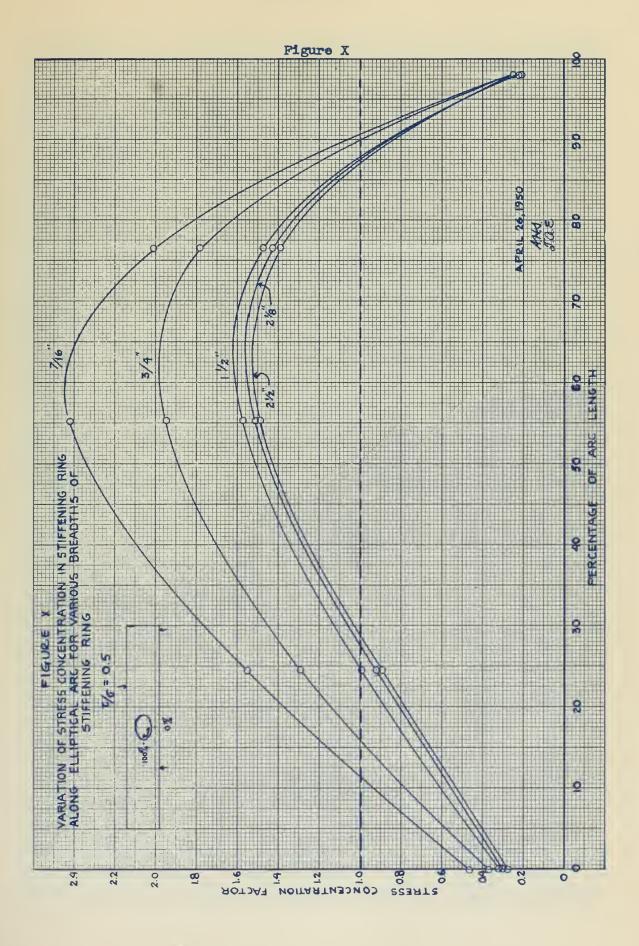
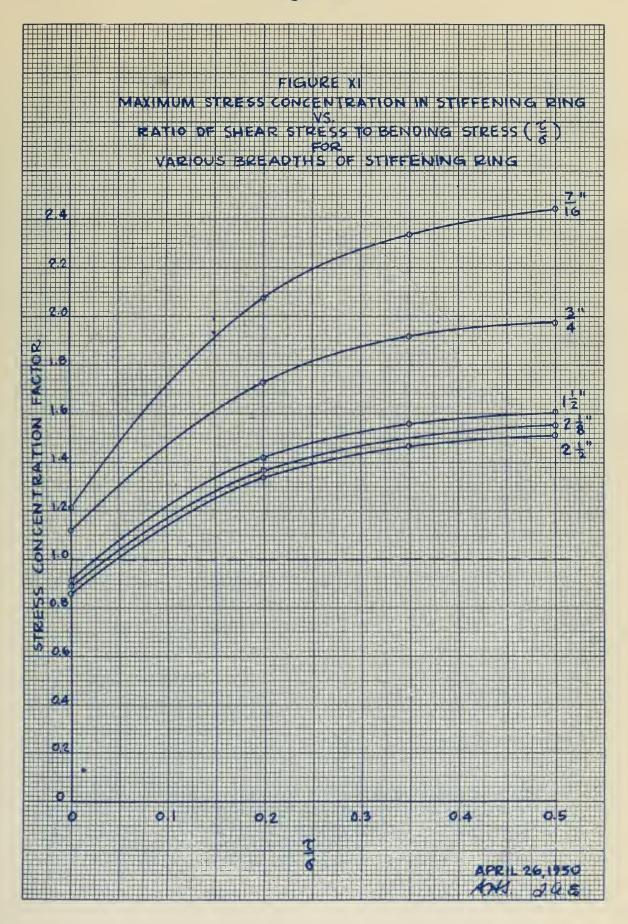




Figure XI



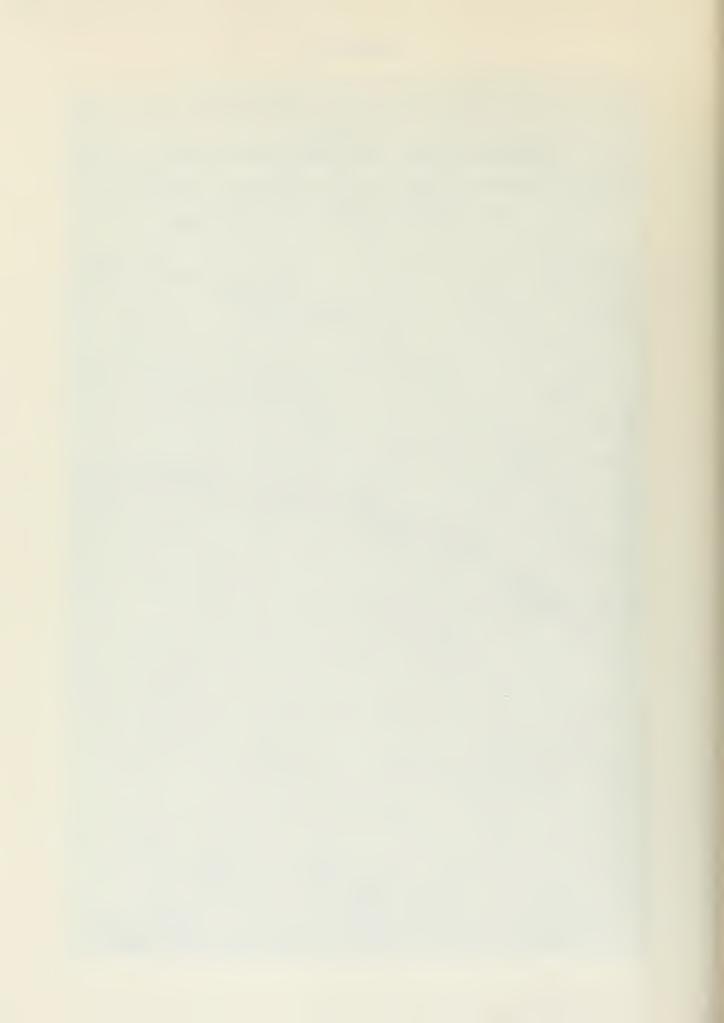
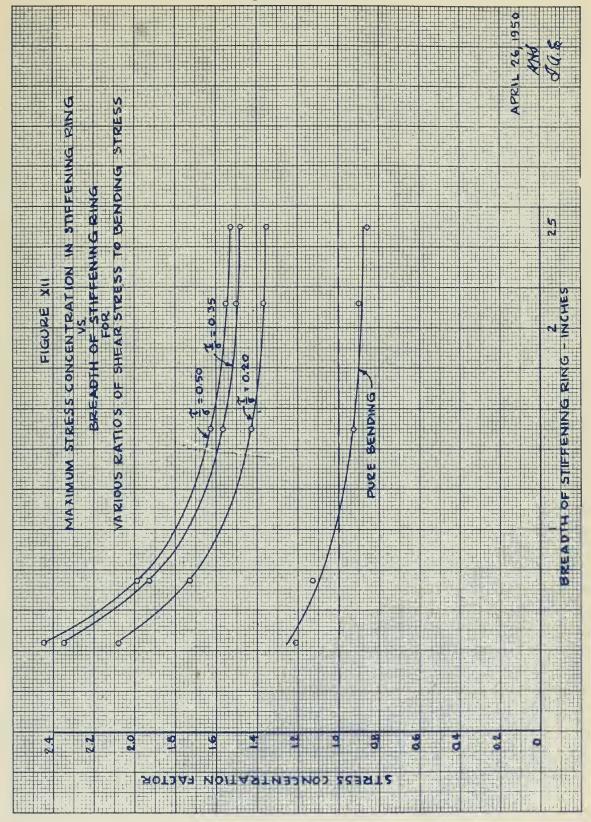


Figure XII



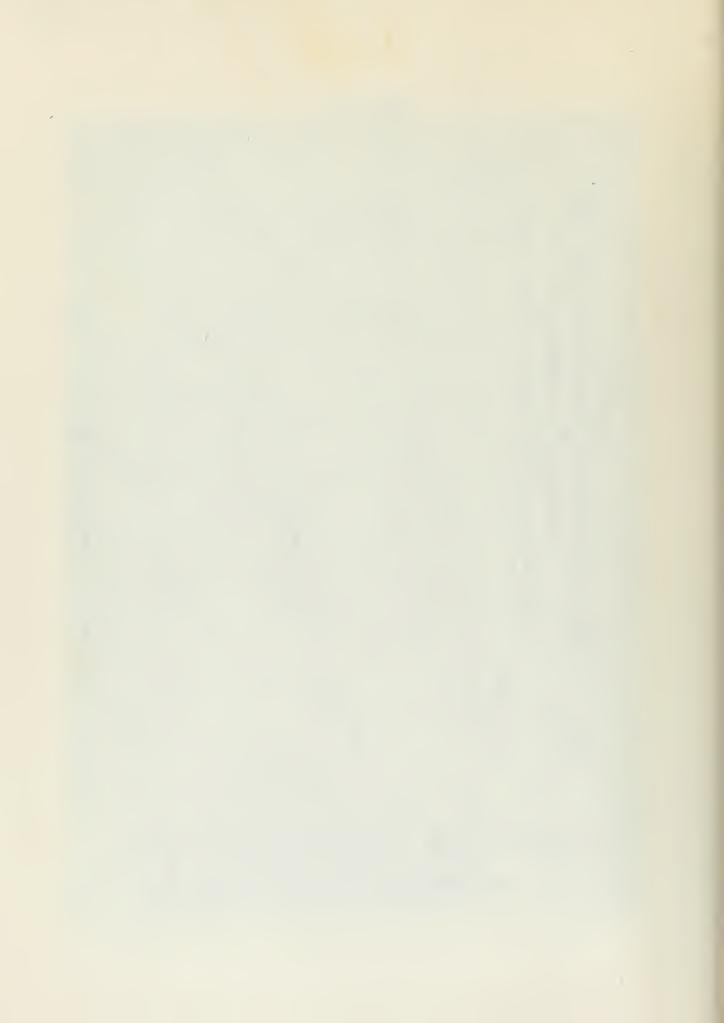
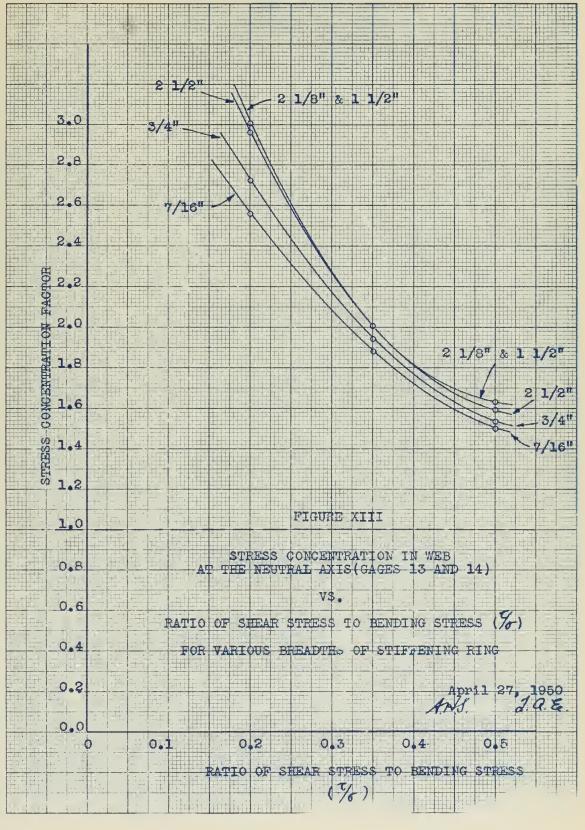


Figure XIII



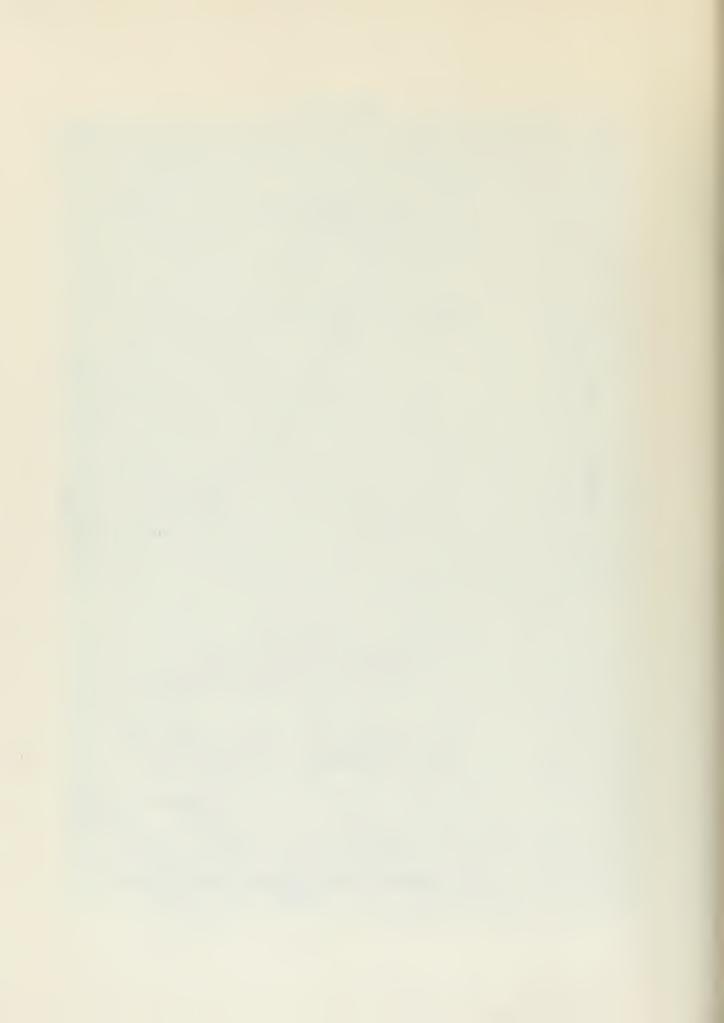
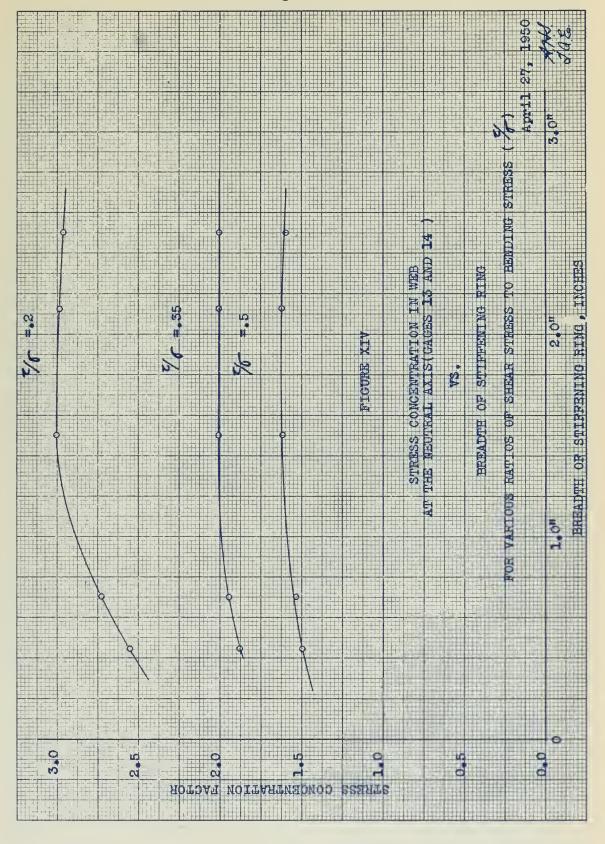


Figure XIV



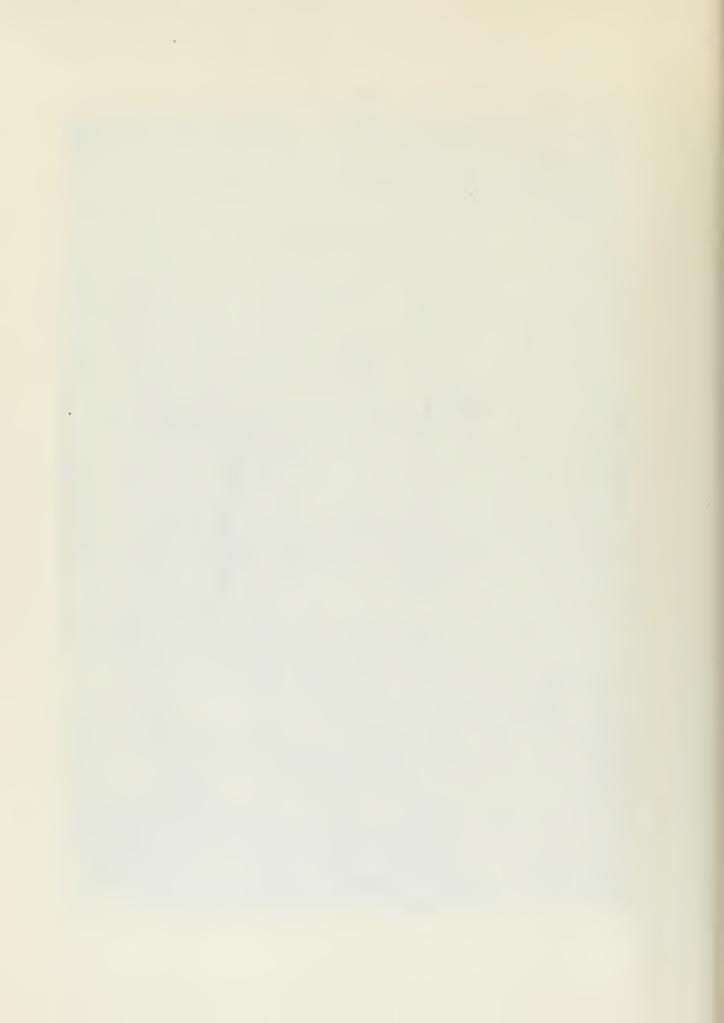
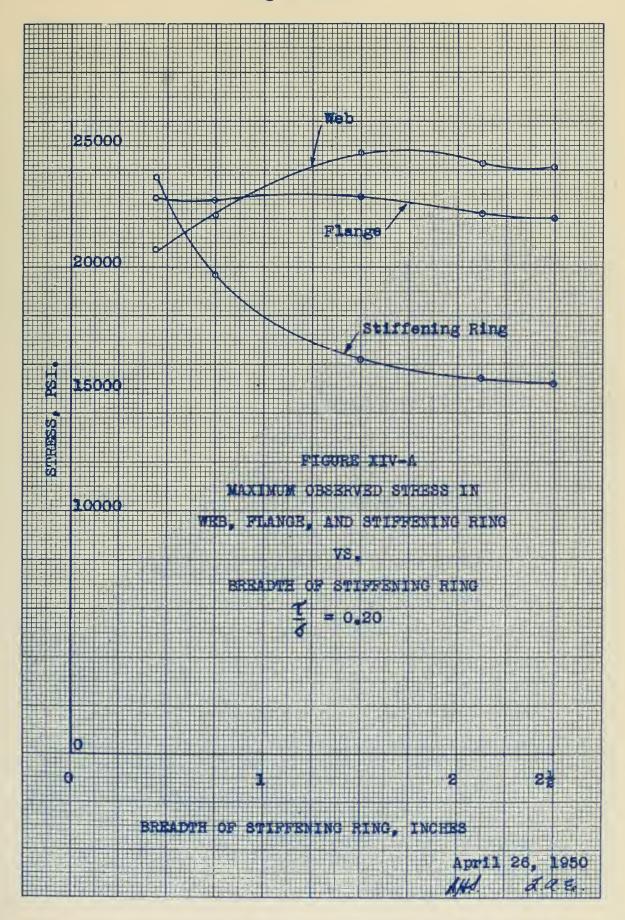


Figure XIV-A



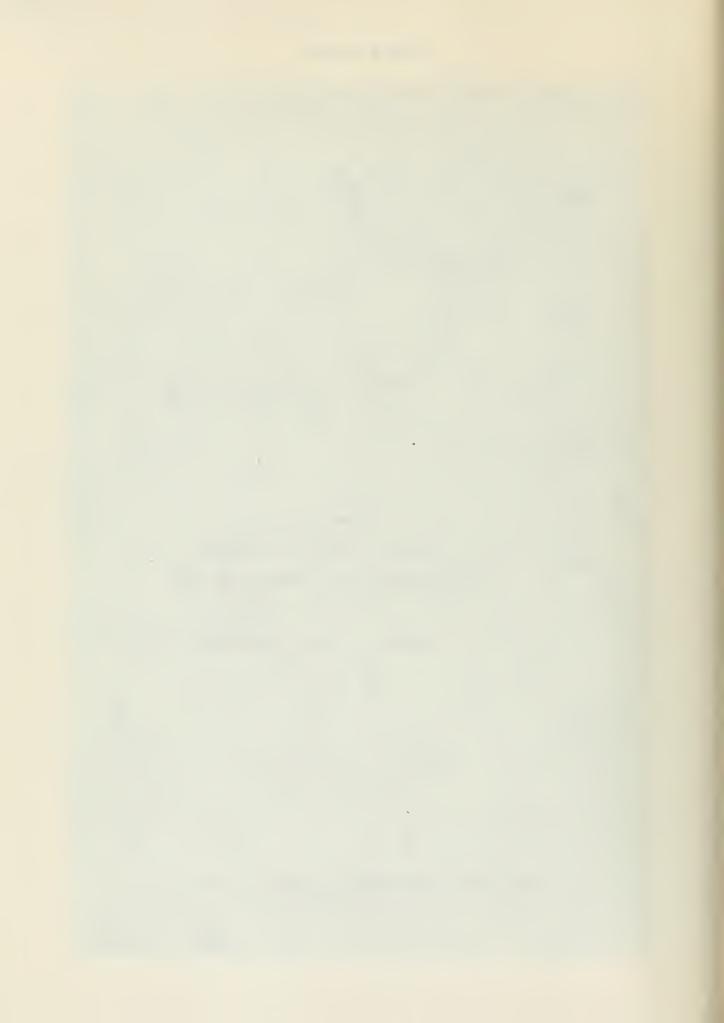
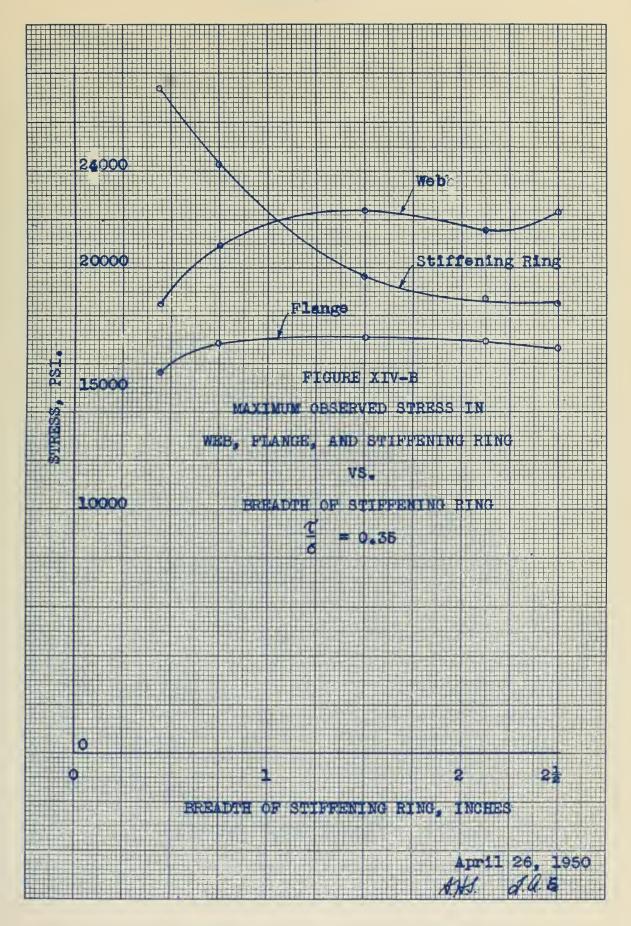


Figure XIV-B





# Figure XIV-C

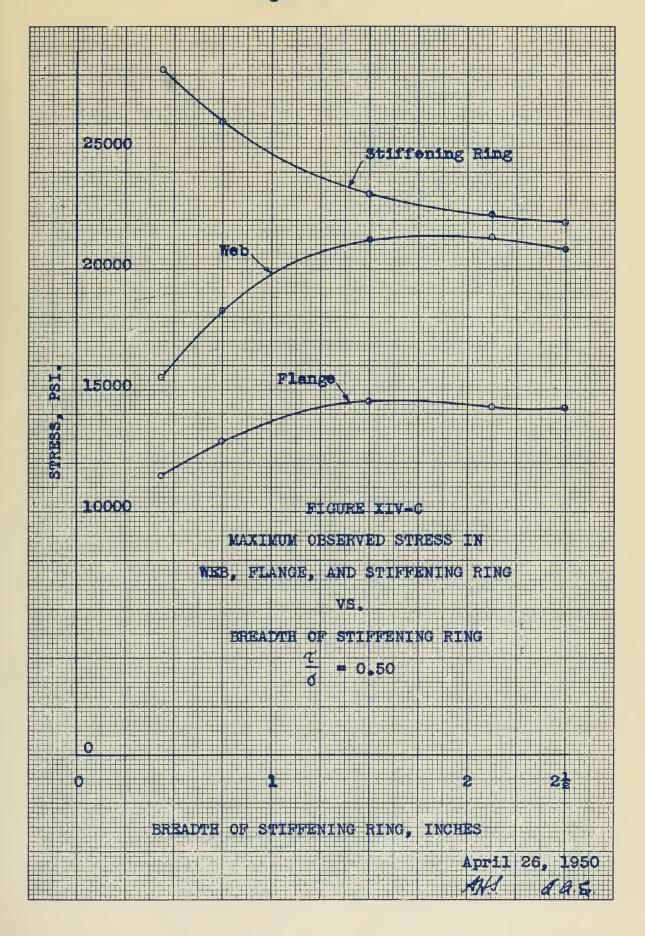
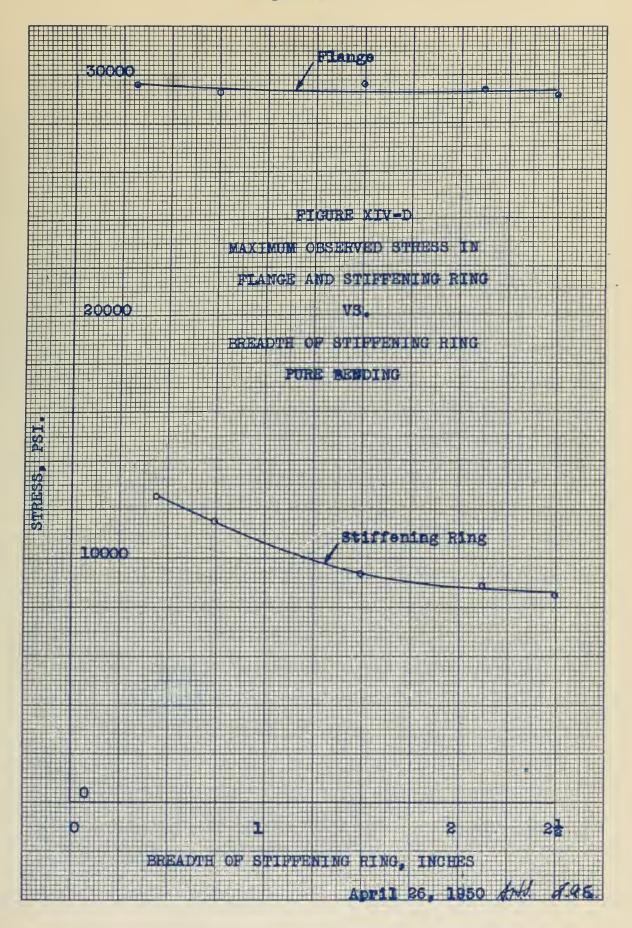
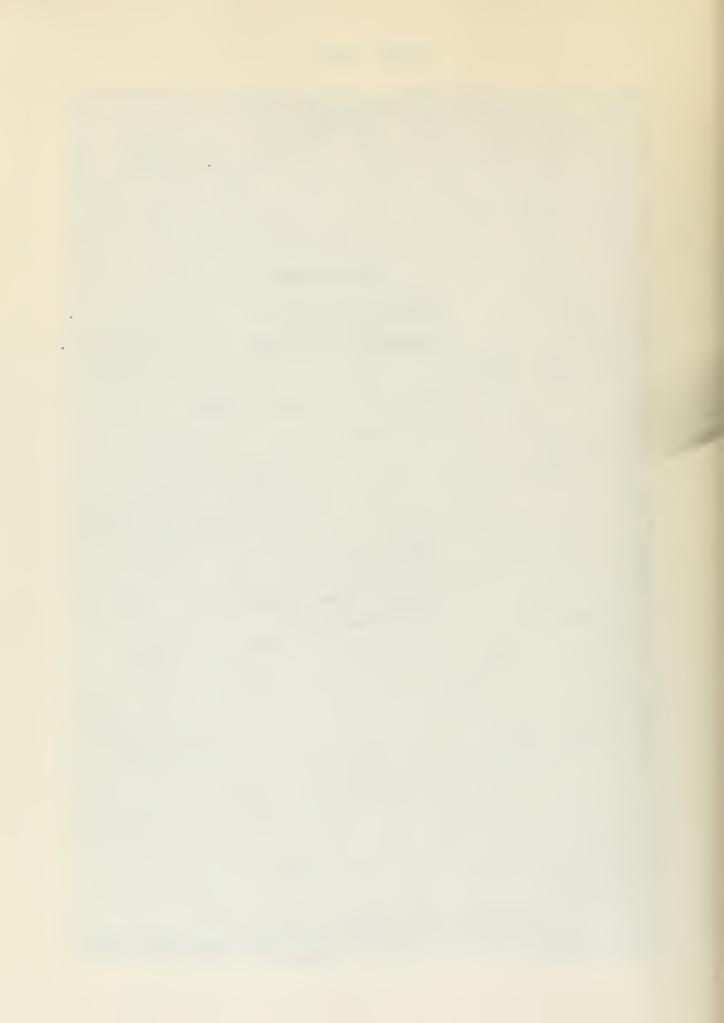




Figure XIV-D

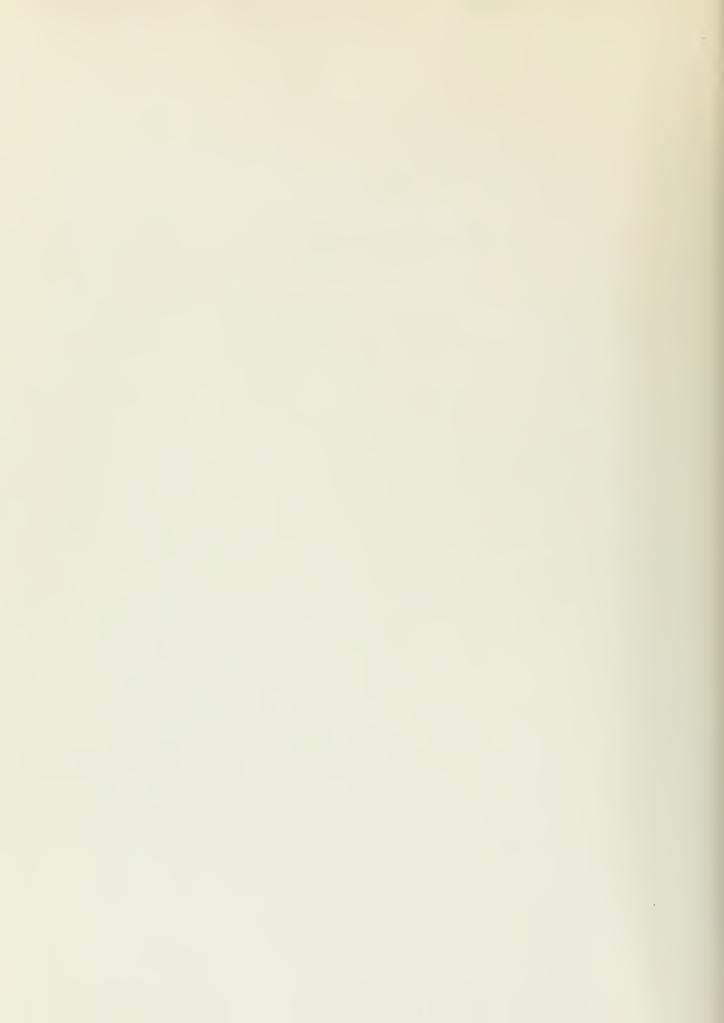




### DISCUSSION OF RESULTS

From a study of Tables I-V it is found that the location of the highest stress in the vicinity of the opening varies with % ratio and breadth of stiffening ring. Figures XIV-A,-B,-C, and-D show the magnitude of the maximum stress as derived from the gage readings for the most highly stressed points in the web, flanges and stiffening ring. The stresses for the web are taken from the readings of gages 13 and 14, those for the flanges from gages 20 and 21, and those for the stiffening ring from gage 17, except those for pure bending which are taken from gage 19, farthest from the neutral axis.

The web is the most highly stressed member at low % ratios, but at % = .50 or greater, the location of the greatest stress is in the stiffening ring. The magnitude of this ring stress is high, and it is evident that yielding will occur in the ring before the web and flange stresses reach even a moderate value. If the breadth of the ring is less than four times the thickness of the web, the ring is the most highly stressed member for % ratios above 0.35. When there is appreciable shear, it appears that there is always the likelihood of yielding in the ring, if its cross-sectional area is small. Hence for an unstiffened opening, the stresses will be high at the edge of the hole if there is appreciable shear.



Since the magnitude of the maximum web stress is always greater than the flange stress it is evident that yielding will take place in the web before it occurs at the extreme fibres, except when % is less than 0.20 and the breadth of the ring less than  $3\frac{1}{2}$  times the web thickness (Figure XIV-A). Thus it is seen that the magnitude of the stress concentrations in the web and stiffening ring are greatly affected by the degree of shear.

#### Stiffening Ring

that the variation of stress concentration along the elliptical arc resembles closely the theoretical curve derived by Joseph and Brock (6) for an unreinforced ovaloid. Due to the fact that all reinforcement could not be removed without disturbing the gages installed, the stress concentration factors found for the elliptical hole are slightly less than the values given by the theoretical curve. Other differences between the observed and theoretical curves may be due to the difference in the shape of the opening. The experimental work of Karl, Heller, and Gerich (8), using a photoelastic model with an ovaloid opening, is also in good agreement with the theoretical curve. Both show that a reversal of stress takes place, as Figure VII indicates.

As shear is introduced, it is seen from Figures VIII, IX and X that the location of the maximum stress shifts toward the mid-length of the arc and is everywhere tensile. For % = 0.20, the maximum value occurs



at about 55% of the arc length for each breadth, and shifts to about 60% for  $\frac{1}{100}$  = 0.35 and 0.50. It will be seen in Tables I-V that the concentration factors for the web gages, although smaller than those factors for the stiffening ring gages, show a slightly greater factor in each case for gages 7 and 8, situated nearly adjacent to the point for 60% of arc on the ring. Thus it is evident that the reinforcing ring is assuming a very large share of the load of the web in its vicinity.

Figures XI and XII are of most interest since they show the variation of maximum stress concentration factor with breadth of reinforcing ring and with loading condition respectively. With an increase of shear, the factor increases rather rapidly at first and then tends to approach a maximum value at a decreasing rate. At % = 0.5, the factor for the 7/16" ring is 1.6 times as great as that for the  $2\frac{1}{2}$ " ring. The factor remains below 1.60 for breadths greater than  $1\frac{1}{2}$ ", but at lesser breadths there is a rapid increase. This ring breadth of  $1\frac{1}{2}$ " may be compared with the breadth of 1.43", which would replace the weight removed from the beam in cutting the elliptical opening. Hence if stresses are to be kept within the yield point, it is evident that the weight of stiffening required will slightly exceed the weight removed in the opening.

The influence of shear may be seen clearly in Figure XII, where the curve for pure bending lies well below those for the conditions with shear. Taking as an example the values of the factor for the case of the  $l_2^{\rm ln}$ 



stiffening ring, in pure bending the factor is 0.92, whereas at % = 0.50, the factor is 1.61, or an increase of 75%. Thus it appears again that the degree of shear to which the section is subjected is of considerable importance.

The results obtained in pure bending are in agreement with those obtained by Ryan and Fischer (4) for the case of an unreinforced circular opening. They found that when the ratio of the diameter of the opening to the depth of the beam is less than  $\frac{1}{2}$ , the maximum stress occurs in the outer edge of the beam. In the present case, the ratio of the minor axis of the elliptical opening to the depth of the beam is 0.362, and it will be found from Table V, minimum reinforcement, for the case of pure bending, that the maximum stresses occur in the outer edge or flange gages (nos. 20-29).

#### Web

The high stress concentration factors found at the location of gages 13 and 14 are of interest, since the calculated stress for the intact beam is least for this point on the neutral axis. It is seen from Figure XIII that the maximum factor obtained, 3.04, occurs at  $\frac{\pi}{6} = 0.20$  and is about the same for the  $2\frac{1}{2}$ ,  $2\frac{1}{8}$  and  $1\frac{1}{2}$  stiffening ring. An increase of the factor with decrease of shear and increase of stiffening ring is contrary to the behavior of the factor for the case of the stresses in the stiffening ring itself, previously mentioned.

Neuber (7) showed in his theoretical solution for stresses around a small elliptical opening in a bar subjected to bending and shear that there was a marked stress concentration due to shear just beyond the ends of the opening on the major (neutral) axis, which decreased to zero at the edge of the bar. His analysis was based on an elongated elliptical opening in a bar of relatively great width compared to the width of the opening. Using his formula for the maximum shear stress concentration

$$\frac{\tau_{\text{max.}}}{2bd} = 3 \frac{\left(\frac{t'}{\beta'} + 2\right)^{3/2} - \sqrt{\frac{t'}{\beta'}}}{\left(\sqrt{\frac{t'}{\beta'}} - 1\right)^2}$$

where t' = length of semi-major diameter

radius of curvature of ellipse at end of semi-major diameter

 $b = \frac{1}{2} depth of the bar$ 

d = thickness of the bar,

the maximum stress concentration factor is found to be 2.25 for the ellipse investigated. Since this calculated value is for an unreinforced opening and results show a decreasing value of stress concentration with reduction in stiffening ring width, the maximum stress concentration of 3.04 appears reasonable.

ī

The stress concentration factor has been defined as the ratio of the observed stress to the theoretical stress of beam theory for the intact beam. The factor for gages 13 and 14 would therefore approach infinity in pure bending, since the theoretical stress is zero at the neutral axis. For the beam with the opening, the latter will of course not be the case, since stress will arise on the neutral axis because of the presence of the opening. This is the reason that the factor in Figures XIII and XIV approaches infinity as  $\frac{\pi}{6}$  approaches zero.

A consideration of the variables involved in the expression for the calculation of the principal stress from observed strains will indicate which of these variables is at this point exerting the greatest influence on the derived stress. Consider, for example, the values given in Table I for  $\frac{1}{6}$  = 0.20 for gages 13 and 14. The strains  $\frac{1}{6}$  = 315,  $\frac{1}{6}$  = -205 are not significantly different in magnitude from the other web gages 1-12 and are nearly equal numerically but of opposite sign. The angle 0, however, has the value 36.2 degrees. Secant 2 9, as used in the calculations, page , becomes secant 72.4 = 3.307, which is three times as large as its value for the angles in the case of the other web gages. Furthermore, a reasonable maximum error of 0.5 degree in measuring this angle from the stresscoat diagram, Figure XVI, would result in a change in secant 2 0 of 5.3%, which would be reflected in the value of the derived stress. Using equations (1), (2), and (3) given in the Appendix, page , in this case the stress concentration



factor would be changed by 4.4%, a figure which represents the maximum expected error for gages 13 and 14. It is evident, however, that this error is not sufficiently large to effect the validity of these results, which were confined by the results of the later tests with the supplementary "A" gages located at the former position of gages 13 and 14, as shown in Figure XXIV. The results obtained from gages 7A, 8A, and 9A in the Appendix, page - , indicate that a stress concentration of the same order of magnitude occurs on the other side of the ellipse. At gages other than 13 and 14, the factors obtained for stresses in the web are comparatively low.

#### Flanges

The stress concentration factor on the outer surface of the flanges of the beam is invariable below unity, except for pure bending, where it reaches its maximum observed value of 1.03 for the  $\frac{7}{16}$  ring in Table V. The factor decreases moderately with increase of  $\frac{1}{16}$  ratio for constant ring breadth but does not show any appreciable change with variation of ring breadth at constant  $\frac{1}{16}$ . This indicates that the maximum stress in the flanges is very little affected by a web discontinuity of the proportions tested, a result substantiated by previous investigators (4).

For conditions of loading other than pure bending, the factor shows its greatest value on the flange in way of the centerline of the opening (gages 20, 21). It decreases moderately with distance toward the left

support, but rises to another maximum (less than the first) in way of the left end of the ellipse (gages 28, 29), never attaining, however, values greater than unity.

For the case of pure bending, the situation is reversed. Here the minimum factor always occurs at the centerline of the hole, while all gages to the left show slightly higher values, never exceeding 1.03.

A typical variation of the factor with distance from the vertical centerline of the ellipse is shown in Figure XLIII.

Figures XXII to XXXIX inclusive show the relationship between load and gage reading for every gage for the tests of the  $1\frac{1}{2}$ " stiffening ring breadth. It is seen that this relationship is essentially linear after initial loading has removed any transverse twist in the beam due to errors of manufacture. After the stiffened opening was fabricated into the beam, it was discovered that the centerline of the web was offset 1/8" from the centerline of the flanges. It is felt, however, that this fact does not appreciably affect the accuracy of the results.

# CONCLUSIONS

- Stress concentrations do exist around a reinforced elliptical discontinuity in a beam subjected to complex bending.
- 2. If the thickness of the reinforcing ring is the same as that of the web, it appears that, from the relative magnitude of the stresses, yielding will take place in the web at the neutral axis before it occurs in the extreme fibres, if \( \frac{7}{6} \) is greater than 0.20 and the breadth of the ring is less than  $3\frac{1}{2}$  times the thickness.
- 3. Yielding will occur first in the stiffening ring if % is greater than 0.50, irrespective of the breadth of the ring.

  If the breadth is reduced to 4 times the thickness, yielding will occur first in the ring if 7 is greater than 0.35.
- 4. The magnitude of the stress concentration in the reinforcement varies directly with the degree of shear and inversely with its cross-sectional area. The variation is not linear.
- 5. The magnitude of the principal stress concentration in the web of the beam at the neutral axis varies inversely with the degree of shear and directly with the cross-sectional area of the reinforcement. The variation is not linear.



- 6. The magnitude of the stress at the most extreme fibres of a wide flange I beam is very little affected by the presence of a centrally-located elliptical discontinuity, reinforced or unreinforced, whose depth is less than 0.36 times the depth of the beam.
- 7. In pure bending, the stress concentration factor nowhere greatly exceeds unity. In the stiffening ring, a reversal of stress occurs which disappears with the introduction of shear.
- 8. Stress concentration factors for the beam are not materially influenced by the width of reinforcing ring until the width is reduced below 7 times the thickness of the web.

### RECOMMENDATIONS

# The authors recommend that

- 1. Further investigation be made of the stress distribution along the neutral axis of a beam in the vicinity of a reinforced discontinuity, the beam being loaded in complex bending.
- 2. A series of tests of ultimate strength be conducted for beams with various breadths of reinforcing ring. Since some local yielding due to high tensile concentrations is not harmful, the ultimate strength of the beam with the stiffened opening may actually exceed that of the intact beam.
- 3. For an opening constructed and reinforced similarly to the one tested, that the breadth of the reinforcing ring be not less than 7 times the thickness of the web.

VIII

APPENDIX

à

#### APP' MDIX A

#### DETAILS OF PROCEDURE

#### A. Beam Selection and Fabrication

The decision having been made to test a beam with a reinforced elliptical discontinuity in complex bending, it was first necessary to decide on parameters and their variation. The parameters chosen were the variation in width of the flat bar stiffening ring and the variation of the ratio of nominal shear stress to bending stress in the intact beam at a section corresponding to the center of the major axis of the elliptical opening. The beam was simply supported, the load being applied at a point 21.5 inches from the center of the hole, and the variation in the ratio of shear stress to bending was effected by varying the distance of the support beyond the hole, as shown in the loading diagrams, Figure II.

The value of shear used in determining the ratio of <u>nominal</u> shear stress to bending stress, hereinafter referred to as  $\sqrt[n]{\sigma}$  was obtained by dividing the magnitude of the variable reaction "v" by the product of the depth of the beam "h" times the thickness of the web t, i. e.,  $\frac{v}{h}$ 



It was desirable to have as large a variation in the ratio of shear stress to bending stress as possible and, with this in mind, a 12" x 6½" x 25# wide flange beam, eleven feet long was selected. This choice was also influenced by the size of the testing machine available as pertains to length and flange width of the specimen, and the desire to have a beam which could be handled easily. A depth of less than twelve inches did not appear feasible considering the amount of space required for strain gage installation.

The elliptically shaped hole was chosen since it permits a large access area for a given beam depth. The true elliptical shape was used in preference to two semi-circles joined by a straight section, since Obermeyer and Ballinger (5) found stress concentrations were set up at the points of tangency of the straight and semi-circular sections. The hole cut in the beam before the reinforcement was installed was 4.3 inches high by 7.2 inches long. This corresponds to a height of 0.4 of the beam depth and the major axis of the ellipse 1.5 times minor axis.

A high tensile steel beam was obtained from and the stiffening ring installed at the Boston Naval Shipyard. The stiffening ring was fabricated from a  $\frac{1}{4}$  x  $2\frac{1}{2}$  mild steel flat bar and welded into the elliptical hole in two sections, with a v- weld at each end of the ellipse at the neutral axis as shown in Figure I. In addition to the installation of the stiffening ring, additional web stiffeners, cut from 10 pound plate,

were installed on either side of the web at a distance of 31 and 62 inches to the right of the hole center line as shown in Figure 2. These stiffeners were installed to reduce any tendency of the beam to twist and to carry the concentrated load into the beam web.

After all welding had been completed, the entire beam was placed in a furnace and stress relieved. The temperature in the furnace was raised from room temperature to approximately 1125°F at a steady rate over a period of 6 hours and 45 minutes. The furnace temperature was maintained at 1125°F for 1 hour, then the furnace was secured and the beam allowed to cool in the furnace for approximately 17 hours.

A standard flat plate tensile specimen in accordance with ASTM specifications was cut from the web of an excess portion of the beam to determine the modulus of elasticity. The modulus of elasticity was obtained as shown in Figure XL and Table XIII. A corresponding tensile specimen was made from a  $\frac{1}{4}$ <sup>n</sup> x  $2\frac{1}{2}$ <sup>n</sup> mild steel flat bar to determine the modulus of elasticity of the stiffening ring. The results of this tensile test are shown in Figure XLI and Table XIV. Both tensile tests were performed in the Baldwin Southwark 60,000 pound testing machine and the strains were measured by a pair of Huggenberger Tensometer gages mounted opposite each other to eliminate any bending effects.

#### B. Stress Coat Tests

In order to determine the lines of principal tensile strain around the access hole, it was necessary to run a series of stress coat tests. Stresscoat is sensitive to temperature and humidity which determine the



proper coating for any given atmospheric conditions. Psychrometer readings of wet-and-dry-bulb air temperatures were taken in the room where the specimen was coated and allowed to dry. Using these two temperature readings, the stresscoat calibration chart was entered and the specified coat selected. The area to be stresscoated was carefully power wire brushed and cleaned with a solvent (Methylisobutylketone). An aluminum-pigmented undercoating was sprayed over the surface in order to accentuate the stress coat cracks. After the aluminum coat had dried about 15 minutes, the stresscoat was sprayed on, using care to spray the coat on evenly and not too thick. Calibration strips were coated with stresscoat at the same time as the beam. The calibration strips, when loaded as a cantilever in the calibrating device, show the approximate sensitivity of the coat which has been applied to the specimen being tested. The nearer the strain cracks approach the point where the calibration strip is loaded, the more sensitive the coating, i. e., the less stress is required to crack it. After allowing the coating to dry 24 hours, the beam was tested for  $\frac{7}{6}$  = 0.2, but the results were inconclusive. The stresscoat was crazed and the 55,000 pound load on the beam was insufficient to crack the stress coat excepting a small area in the web near the outer flanges. The calibration strips showed a strain sensitivity of 0.0006 corresponding to a stress of approximately 18,000 pounds per square inch.

This stress coat was removed, the beam cleaned, and another coat applied, using the procedure described above. The technique for spraying the stress coat was better and a more uniform coat was obtained. The strain sensitivity for this coat was 0.00112, corresponding to about 33,000 psi required to crack the stress coat. This figure, coupled with the previous test, showed that the coat must be made more sensitive if any cracks were to be obtained. Due to the method of loading and the stress concentration directly beneath the load, the beam would yield at this section before it was possible to have sufficiently high stresses in way of the hole to crack the stresscoat possessing this low sensitivity. The beam was loaded to approximately 40,000 pounds and the area to which the stresscoat had been applied was suddenly cooled by a blast from a CO, fire extinguisher. A pattern of very fine cracks was obtained. These cracks were viewed most clearly by shining a flashlight on the surface at an angle in order to accentuate the discontinuities in the stress coat surface. To obtain a permanent record of these crack patterns, the contour of the cracks was first sketched on the beam in soft red pencil and then copied directly on tracing paper which was cut to fit on the beam web over the stress coated area. This tracing was oriented by centerlines scribed on the beam. An alternative method of recording the cracks is to use a red dye etch on the surface, wipe it off and photograph the strain pattern as outlined by the dye remaining in the cracks. However, the strain lines are so close together when obtained by suddenly chilling the beam that differentiation between the lines is rather poor.



The tracing procedure proved satisfactory and was used to record the strain cracks for % = 0.2, 0.5 and pure bending as shown in Figures XV thru XVII.

#### C. Strain Gage Installation

The stress coat tests gave lines which were normal to the principal tensile strains. Because of the expense of the gages and limitation of time, only one quadrant of the ellipse was selected for detailed investigation. Figures XV and XVI showed that the greatest positive strains in the stiffening ring would occur in the lower left hand quadrant for the beam oriented as shown with the load to the right side of the hole; accordingly this quadrant was investigated.

The desire to get as near the stiffening ring as possible on the web, and to have the strains at a number of points, necessitated a relatively small strain gage, and precluded use of the rosette type. The gage best suiting these conditions as determined from Baldwin Bulletins (9-10) was the type A-3, SR-4 cupro nickel wire strain gage. These gages have a 1/8 inch gage length so the strains measured were quite well pin-pointed. To limit the number of gages to be installed in the web, only seven gages were applied to each side with the adjacent gages oriented normal to each other as shown in Figure I. In order to utilize this method, it was essential that none of the strain gages make an angle of 45° with any of the lines of principal strains, because in combining the measured strains in Mohr's circle using twice the angle between the axis of the gage and a line normal to the strain cracks at



the gage, an indeterminate condition would obtain if this angle were 45°. With this in mind, it was found by examining the stress coat patterns for all conditions of loading that the optimum gage orientation was 20° to the horizontal axis of the beam, with alternate gages normal to this orientation. Gages were placed in the same position and orientation on opposite sides of the web to eliminate the effect of any bending or twisting which might be introduced.

Five gages were placed inside the stiffening ring extending from the major axis to the minor axis of the elliptical arc chosen for investigation. These gages were placed in the vertical centerline plane of the web. Ten gages were placed on the top and bottom flanges of the beam, in a line coinciding with the centerline of the web and extending from the vertical centerline of the ellipse to a point approximately the same distance out as the gages installed on the neutral axis. It was desired to measure the strains in the flanges as well as the strains about the hole since Ryan and Fischer (4) found in studying beams with a central hole subjected to pure bending, that, if the ratio of the diameter of the hole to the depth of beam is less than \( \frac{1}{2} \), the maximum stress occurs on the outer edge of the beam and is approximately equal to the stress in the beam without the hole. If the ratio is greater than \( \frac{1}{2} \) the edge of the hole becomes critical.

With the gage locations established, the area to receive gages was roughened with No. 000 sand paper and each gage location marked on the beam. Duco Household Cement was used to cement the strain gages in place.

The gages were covered with sponge rubber backed by a piece of 3-ply wood and held in place by clamps. The clamps were tightened just sufficiently to hold the sponge rubber in place. The clamps were removed after two days, but the gages were allowed to dry for a week before being used. Before soldering on leads of No. 20 copper wire, all the gages were checked by means of a volt-chameter for continuity, grounds and specified resistance. All connections were soldered using rosin core solder.

#### D. Instrumentation

The instruments used to measure the strains were two Baldwin SR-4
Twenty-point switching units and a Baldwin Portable Strain Indicator,
Model K. The switching unit combines a unique circuit which virtually
eliminates all errors due to contact resistance. One dummy gage was
used for all measurements and was mounted on the tensile test specimen
taken from the beam web. During all tests this specimen was resting on
the lower flange of the beam adjacent to the gages being tested, as can
be seen in Figure VI. In order to utilize only one dummy gage with the
switching units, all the dummy gage terminals on the end of the switching units were connected in series by a bare copper wire. The dummy
gage terminals in the two switching units were then connected together.
This wiring set up, as shown schematically in Figure XLII, permitted all
gages to be switched into the Strain Indicator without shifting any
connections.



#### E. Recording of Data

With the beam installed in the 100,000 pound Riehle testing machine as shown by the loading diagrams. Figure II and photographs Figures III through VI and all the instruments and gages properly connected, it was possible to start recording data. With the beam in position for a given ratio of shear stress to bending stress, or pure bending, as the case might be, an initial reading was taken for all strain gages using the strain indicator, which gives readings directly in micro-inches. The load was applied in four increments up to the maximum load and then decreased by the same increments down to zero. Strain readings were recorded for each increment of load, both increasing and decreasing. The strain for each load in each case is the difference between the value read at the load and the initial reading. Approximately 12 hours were required to make a complete set of readings for a given ratio. Readings were taken both for increasing load and decreasing load in order to check the reliability of the gages. Figures XXVII through XXXIX show load vs. strain for all gages when the stiffening ring was la inches wide.

### F. Method of Reducing Width of Stiffening Ring

The stiffening ring width was reduced by clamping the beam, with the web horizontal, in a shaper then cutting transversely across the ring from one side to the other. This method proved very effective since the rate of cutting was slow enough that the heat generated was



insufficient to adversely affect the installed strain gages. However, it required extensive handling of the beam, since the shaper was located in the basement below the testing machine. In an attempt to eliminate unnecessary handling, the first reduction in stiffening ring width from 21 to 2 1/8 inches was accomplished by using a 1 x 9 inch diameter cutting-off wheel driven by an air motor. The air motor was mounted in a jig which rested on the edges of the beam flanges so that the plane of the cutting off wheel was parallel to the beam web. This method proved unsatisfactory because the heat generated necessitated light cuts with intervals for cooling and required an excessive amount of time to perform the operation. As the width of the stiffening ring approached the thickness of the web there was danger of a chip damaging the gages installed on the web. The trim width of the A-8 gages installed on the stiffening ring was 5/16 of an inch while the web thickness was 0.24 inches. For these reasons the stiffening ring width was not reduced below 7/16 inch which allowed approximately 0.1 inch on each side of the web.

# G. Stresscoat Test After Stiffening Ring Reduced to 7/16"

After completion of all strain gage measurements it was deemed desirable to make another stresscoat test to determine whether there was any appreciable change in the direction of the strain cracks after the stiffening ring had been reduced to 7/16 inch. This necessitated the removal of all the strain gages applied to the web. With the beam



stress coated as before it was tested for a value of  $\frac{7}{6}$  = 0.5. The results of this test are shown in Figure XVIII, and also are shown superimposed for comparison on the original pattern for this ratio of  $\frac{7}{6}$  in Figure XV.

#### H. Installation of Supplementary "A" Gages on the Neutral Axis

As a result of calculation based on the original data, it appeared that an extraordinary high stress concentration existed at the point where gages 13 and 14 were installed on the neutral axis. Since the strains normal to the orientation of gages 13 and 14 were extrapolated from gages 11 and 12 in the manner shown in Figures XIX through XXIII, it seemed advisable to obtain these normal strains as near to gages 13 and 14 as possible by direct measurement. Therefore, gages were reinstalled at the same location with the same orientation as gages 13 and 14, plus two more pairs of gages as close as possible on either side of the neutral axis and oriented normal to the orientation of gages 13 and 14 as shown in Figure XXIV. Use of rosette type gages was precluded by space considerations. Gages were also placed in a similar location at the opposite end of the elliptical opening, but only on one side of the beam, because no additional gages were available. The weld in the stiffening ring adjacent to gages 13 and 14 had a flaw which became apparent when the stiffening ring was reduced down to 3/4 inch width. It was thought that this flaw may have given rise to the stress concentration noted at gages 13 and 14 which are approximately 3/4 inch from the flaw. Since the weld was apparently satisfactory on the opposite side of the ellipse, the



installations of gages here would indicate whether the weld had a marked influence on the stress concentration factor. The location of these gages is shown in Figure XXIV. Following their installation, and, using the same procedure as before, the beam was tested again for % = 0.2, 0.35, 0.5 and pure bending, and the data recorded as previously.

In order to obtain strains normal to the strains for gages 13 and 14 for all widths of stiffening ring an interpolation plot, Figure XXIV-A, was made from data obtained using the supplementary gages. Provided the material is not stressed beyond the yield point, the ratio of strains which are mutually perpendicular at a given point are constant for each loading condition. Therefore, the average strains for gages 1A, 2A, 5A and 6A were plotted vs. the average strains for gages 3A and 4A for each increment of load. Then, for any stiffening ring width, to obtain the strains normal to gages 13 and 14 which were located and oriented the same as the supplementary gages 3A and 4A, it is only necessary to enter Figure XXIV-A with the value of strain read by gages 13 and 14 and read off the corresponding normal strain. The method actually used in Table XII consisted of multiplying the strains measured by gages 13 and 14 by the tangent of the angle  $\prec$  shown in Figure XXIV-A.



## APPENDIX B

SUMMARY OF DATA AND CALCULATIONS



TABLE I Observed Strains and Stress Concentration Factor for Each Gage Location Stiffening Ring Breadth =  $2\frac{1}{2}$ "

	7/6 = 0.20, Load 37740 Lbs.									
Gege No.	€ <sub>x</sub>	€ <sub>y</sub>	e degrees	ε <sub>1</sub> x106	€ <sub>2</sub>	Ó1 psi	ol (calc)	Stress conc. factor		
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	480 435 408 405 405 385 315	-208 -100 - 5 15 - 58 -255 -295	10.8 80.3 5.4 88.5 0.0 83.6 36.2	505.9 451.1 411.7 405.2 405.0 393.2 1016.6 62.0 418.0 538.0 445.0 230.0 728.0 702.0 676.0 654.0 660.0	-233.9 -116.1 - 8.7 14.8 - 58.0 -263.2 -998.6	14490 13810 13540 13550 12840 10480 24120 1753 11820 15210 12580 6504 22060 21270 20480 19820 20000	15540 15190 14710 13840 12600 10450 8123 8215 9812 11310 12590 13060 23090 22590 22130 21820 21340	.93 .91 .92 .98 1.02 1.00 2.96 .21 1.20 1.34 1.00 .50 .94 .93 .90		
			4/6	= 0.35,	Load 40000	Lbs.				
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	464 406 387 390 400 418 420	-298 -136 0 28 - 50 -308 -409	12.1 77.7 14.2 74.7 1.5 84.2 31.9	501.0 433.0 413.5 419.3 400.3 425.7 944.3 85.0 564.0 459.0 486.0 429.0 436.0	-335.0 -163.0 - 26.5 - 1.3 - 50.3 -315.7 -933.3	13360 12760 13420 13858 12760 11050 22284 2404 15950 18490 12700 4411 16630 14720 13660 13000 13210	15600 15250 14890 14330 13560 12190 10700 10800 11880 12860 13710 14040 17490 16840 16220 15800 15170	.86 .84 .90 .97 .94 .91 2.08 .22 1.34 1.44 .93 .31 .95 .88 .84 .82		



TABLE I (cont'd)

	1/6 = 0.50, Load 44000 Lbs.									
Gage No.	x x106	€y xl06	degrees	€ <sub>1</sub> x106	€ <sub>2</sub>	O <sub>1</sub> psi	Ol (calc) psi	Stress conc. factor		
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	490 420 399 408 430 479 505	-375 -161 15 52 - 38 -359 -486	13.5 75.1 23.0 60.9 3.0 84.7 27.6	543.4 464.3 483.4 567.8 431.3 486.3 877.7 119.0 686.0 774.0 486.0 128.0 470.0 380.0 342.0 317.0	_427.9 _205.3 _ 69.4 _107.8 _ 39.3 _366.3 _858.7	13870 13390 15320 17750 13890 12570 20790 3365 19400 21890 13740 3620 14240 11510 10360 9756 9605	16230 15820 15230 14170	.82 .81 .94 1.12 .91 .89 1.59 .25 1.39 1.49 .89 .23 .95 .81 .77 .76		
			Pure	Bending,	Load 440	OO Lbs.				
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	364 342 330 322 297 185 5	13 2 - 11 - 22. - 33 - 47 - 52	21.4 59.0 28.1 62.6 24.4 78.0	427.7 534.1 466.0 448.5 382.5 196.0 4.0 8.0 118.0 296.0 301.0 928.0 926.0	- 50.7 -190.1 -147.0 -149.0 -118.5 - 58.0	13660 15850 14000 13410 11516 5928 113 226 3337 8371 8512 28120 28060 29030 29120	14080 13450 12120 9980 5780 387 4365 7475 9712 10420 28870 28870	.94 1.12 1.04 1.11 1.15 1.03 .29 .05 .45 .86 .82 .97 .97		



TABLE II

Observed Strains and Stress Concentration Factor for Each Gage Location
Stiffening Ring Breadth = 2-1/8"

	% = 0.20, Load 37740 Lbs.									
Gage No.	€ x x106	€ y x106	degrees	€ <sub>1</sub> *106	€ <sub>2</sub>	S <sub>1</sub> psi	Ol (calc) psi	Stress conc. factor		
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	492 445 420 420 420 375 317	-230 - 89 0 19 - 55 -245 -295	10.8 80.3 5.4 88.5 0.0 83.6 36.2	519.3 461.1 423.8 420.0 382.9 1022.9 60.0 427.0 545.0 248.0 734.0 701.0 663.0 663.0	-257.3 -105.1 - 3.8 18.7 - 55.0 -252.9 -1000.9	14710 14240 13980 14080 13360 10240 24230 1697 12070 15410 13150 7013 22240 20090 19970 20090	15540 15190 14710 13840 12590 10450 8123 8215 9812 11310 12580 13060 23090 22590 22140 21820 21342	.95 .94 .95 1.06 .98 2.98 2.98 1.36 1.05 .94 .95 .91		
			4/3	= 0.35,	Load 40000	Lbs.				
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	475 415 398 403 412 409 405	-325 -127 3 33 - 59 -358 -389	12.1 77.7 14.2 74.7 1.5 84.2 31.9	513.9 432.0 425.0 432.9 412.3 468.2 967.2 85.0 568.0 661.0 460.0 163.0 557.0 495.0 442.0 443.0	-363.9 -154.0 - 24.0 - 3.1 - 59.3 -417.2 -891.2	13510 12810 13830 14350 13070 11480 21460 2404 16060 13010 4610 16880 15000 13910 13390 13420	13710 14040 17490 16840 16220 15800	.87 .84 .93 1.00 .96 .94 2.01 .22 1.35 1.45 .95 .89 .89 .89		



TABLE II (cont'd)

	1/6 = .50, Load 44000 Lbs.									
Gage No.	€ <sub>x</sub> xl06	€ y x106	degrees	€ <sub>1</sub>	€ <sub>2</sub>	δ <sub>1</sub> psi	Oi (calc) psi	Stress conc. factor		
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	498 426 408 415 433 482 518	-450 -165 ? 45 - 36 -405 -498	13.5 75.1 23.0 60.9 3.0 84.7 27.6	556.0 471.0 496.1 581.1 434.3 479.5 900.1 101.0 705.0 786.0 501.0 138.0 473.0 393.0 347.0 325.0 326.0	-508.0 -210.0 - 81.1 -121.1 - 37.3 -402.5 -880.1	13520 13570 15630 18060 14010 10330 21330 2856 19940 22230 14170 3903 14330 11190 10510 9847 9878	16870 16570 16230 15820 15230 14170 13070 13160 13980 14740 15410 15720 14765 14170 13420 12900 12130	.80 .82 .96 1.14 .92 .73 1.63 .22 1.43 1.51 .92 .25 .96 .81 .78 .76		
			Pure	Bending,	Load 4400	O Lbs.				
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	384 368 345 329 313 193 11	18 2 - 15 - 24 - 30 - 35 - 33	21.4 59.0 28.1 62.6 24.4 78.0	450.4 574.8 488.6 458.7 401.9 203.8 5.0 1.0 132.0 307.0 940.0 954.0 972.0 965.0 972.0	- 48.4 -204.8 -158.6 -153.7 -118.9 - 45.8	14440 17050 14640 13700 12150 6302 141 28 3733 8682 8965 28480 28900 29450 29450	14610 14080 13450 12120 9980 5780 387 4365 7475 9712 10420 28870 28870 28870 28870 28870	.99 1.21 1.09 1.13 1.22 1.09  .36 .06 .50 .89 .86 .99 1.00 1.02 1.01 1.02		



TABLE III Observed Strains and Stress Concentration Factor for Each Gage Location Stiffening Ring Breadth =  $1\frac{1}{2}$ "

	1/5 = 0.20, Load 37987 Lbs.									
Gage No.	€ x x106	€ y x106	degrees	€ 1 x106	x106	l psi	Si (calc)	Stress conc. factor		
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	506 475 447 440 434 374 323	-186 -100 - 23 12 - 48 -241 -301	10.8 80.3 5.4 88.5 0.0 83.6 36.2	532.1 491.3 451.2 440.3 434.0 380.8 1042.7 53.0 445.0 571.0 506.0 264.0 755.0 694.0 678.0	-212.1 -117.3 - 27.2 11.7 - 48.0 -248.8 -1020.7	15570 15130 14665 14450 13900 10210 24700 1500 12580 16150 14310 7460 22880 21660 21030 20420 20540	15540 15190 14710 13840 12590 10450 8123 8276 9880 11390 12670 13150 23250 22750 22290 21970 21490	1.00 1.00 .99 1.04 1.10 .98 3.04 .18 1.27 1.42 1.13 .57 .98 .95 .92 .93 .95		
			1/0	= 0.35,	Load 3994	5 Lbs.				
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	481 423 419 421 422 423 423	-270 -137 - 23 27 - 38 -302 -407	12.1 77.7 14.2 74.7 1.5 84.2 31.9	516.4 450.9 449.2 452.9 422.3 431.7 948.0 73.0 590.0 694.0 508.0 185.0 564.0 564.0 463.0 444.0 448.0	-306.4 -164.9 - 30.2 - 4.9 - 38.3 -309.7 932.0	14140 13330 14570 14940 13600 11310 22420 2064 16680 19630 14370 5230 17090 15210 14030 13450 13570	15600 15250 14890 14330 13570 12190 10700 10800 11880 12860 13710 14040 17500 16841 16225 15800 15170	.91 .87 .98 1.04 1.00 .93 2.09 1.40 1.53 1.05 .37 .98 .90 .85 .89		



TABLE III (contid)

			7/0	s = 0.50,	Load 43950	Lbs.		
Gage No.	x106	€ y x106	degrees	£1 x106	€ <sub>2</sub>	∫ <sub>l</sub> psi	O1 (calc) psi	Stress conc.
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	496 462 429 427 443 490 515	-355 -170 - 18 - 41 - 38 -357 -495	13.5 75.1 23.0 60.9 3.0 84.7 27.6	547.0 510.1 544.0 600.2 444.3 496.4 894.9 98.0 727.0 816.0 540.0 140.0 478.0 398.0 346.0 328.0 327.0	_407.0 =218.1 =116.0 =132.2 = 39.3 -364.4 =874.9	14190 14780 16880 18580 14320 12920 21210 2770 20560 23080 15270 3960 14480 12060 10480 9938 9908	16870 16570 16230 15820 15230 14170 13070 13160 13980 14740 15410 15720 14965 14170 13420 12900 12130	.84 .89 1.04 1.17 .94 .91 1.62 .21 1.47 1.57 .99 .25 .97 .85 .78 .77
			Pure	Bending,	Load 4398	O Lbs.		
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27	374 360 341 320 292 163 - 8	26 - 4 - 25 - 37 - 36 - 35 - 35	21.4 59.0 28.1 62.0 24.4 78.0	437.1 565.7 487.0 450.8 377.0 172.4 5.0 -16.0 107.0 312.0 332.0 944.0 960.0 977.0 972.0	- 37.1 -209.7 -171.0 -166.8 -121.0 - 9.4	15300 16700 14470 13310 11310 5614 141 452 3026 8823 9389 28600 29090 29600 29450	14610 14080 13450 12120 9980 5780 387 4365 7475 9712 10420 28870 28870 28870 28870	1.04 1.19 1.07 1.10 1.14 .97 .36 10 .40 .91 .89 .99 1.01 1.02 1.02

TABLE IV

Observed Strains and Stress Concentration Factor for Each Gage Location Stiffening Ring Breadth = 3/4"

			40	= 0.20,	Load 38005	Lbs.		
Gage No.	E <sub>x</sub>	€y x106	degrees	€ <sub>1</sub>	€ <sub>2</sub> x10 <sup>6</sup>	O <sub>1</sub> psi	Ol (calc) psi	Stress conc. factor
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	517 512 507 497 473 395 290	-214 -125 - 43 - 21 - 82 -232 -269	10.8 80.3 5.4 88.5 0.0 83.6 36.2	543.5 531.1 511.9 497.4 468.0 402.0 934.8 58.0 523.0 696.0 650.0 329.0 751.0 701.0 676.0 663.0 664.0	-392.5 -143.1 - 47.9 - 21.4 - 87.0 -240.0 -913.8	14210 16200 16474 16250 14650 10980 22160 1640 14790 19680 18380 9300 22750 21240 20480 20090 20120	15540 15190 14710 13840 12590 10450 8123 8276 9880 11390 12670 13150 23250 22750 22290 21970 21490	.91 1.08 1.12 1.17 1.16 1.05 2.73 .20 1.50 1.73 1.45 .71 .98 .94 .92 .91 .93
			7/0	= 0.35,	Load 39955	Lbs.		
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	487 492 491 490 485 445 394	-270 -148 - 35 - 4 - 70 -290 -379	12.1 77.7 14.2 74.7 1.5 84.2 31.9	522.7 523.9 527.0 530.0 484.4 451.8 882.9 87.0 710.0 858.0 658.0 227.0 555.0 443.0 429.0 430.0	-306.7 -179.9 - 71.0 - 44.0 - 70.4 -297.8 -867.9	14350 15600 16752 17110 15350 12088 20880 2460 20080 24260 18600 6420 16820 14420 13420 13000 13030	15600 15250 14890 14330 13570 12190 10700 10800 11880 12860 13710 14040 17500 16841 16225 15800 15170	.92 1.02 1.12 1.19 1.13 .98 1.95 .23 1.69 1.89 1.36 .46 .96 .86 .83 .82

TABLE IV (contid)

			4/6	= 0.50,	Load 39995	Lbs.		
Gage No.	€ x x106	€y xl06	degrees	€ <sub>1</sub>	€ <sub>2</sub>	ර <sub>1</sub> psi	ol (calc)	Stress conc. factor
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	498 472 463 469 472 462 443	-322 -164 - 22 9 - 54 -308 -426	13.5 75.1 23.0 60.9 3.0 84.7 27.6	548.0 520.0 568.0 675.0 473.4 546.0 769.8 108.0 801.0 922.0 641.0 158.0 426.0 346.0 294.0 279.0	-373.0 -212.0 -128.0 -197.0 - 55.4 -238.0 -752.8	14560 15150 17560 20440 15110 15780 18250 3054 22650 26070 18130 4468 12900 10480 8910 8423 8454	15320 15050 14740 14365 13830 12870 11870 11970 12710 13400 14000 14290 13600 12880 12190 11720 11020	.95 1.01 1.19 1.42 1.09 1.23 1.54 .25 1.78 1.95 1.29 .31 .95 .81 .73 .72 .76
			Pure	Bending,	Load 4398	O Lbs.		
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	408 391 362 330 279 130 -28	- 10 - 31 - 50 - 55 - 56 - 36 - 19	21.4 59.0 28.1 62.0 24.4 78.0	483.8 629.4 526.3 470.1 365.5 137.8 - 2.0 -41.0 107.0 383.0 409.0 931.0 950.0 964.0 965.0 966.0	- 85.8 -269.4 -214.3 -196.1 -141.5 - 43.8	15180 18240 15360 13670 10730 4140 - 56 -1160 3026 10831 11560 28210 28780 29210 29240 29270	14610 14080 13450 12120 9980 5780 387 4365 7475 9712 10420 28870 28870 28870 28870 28870 28870	1.04 1.30 1.14 1.13 1.08 .711427 .40 1.12 1.11 .98 .99 1.01 1.01 1.01

TABLE V

Observed Strains and Stress Concentration Factor for Each Gage Location Stiffening Ring Breadth = 7/16"

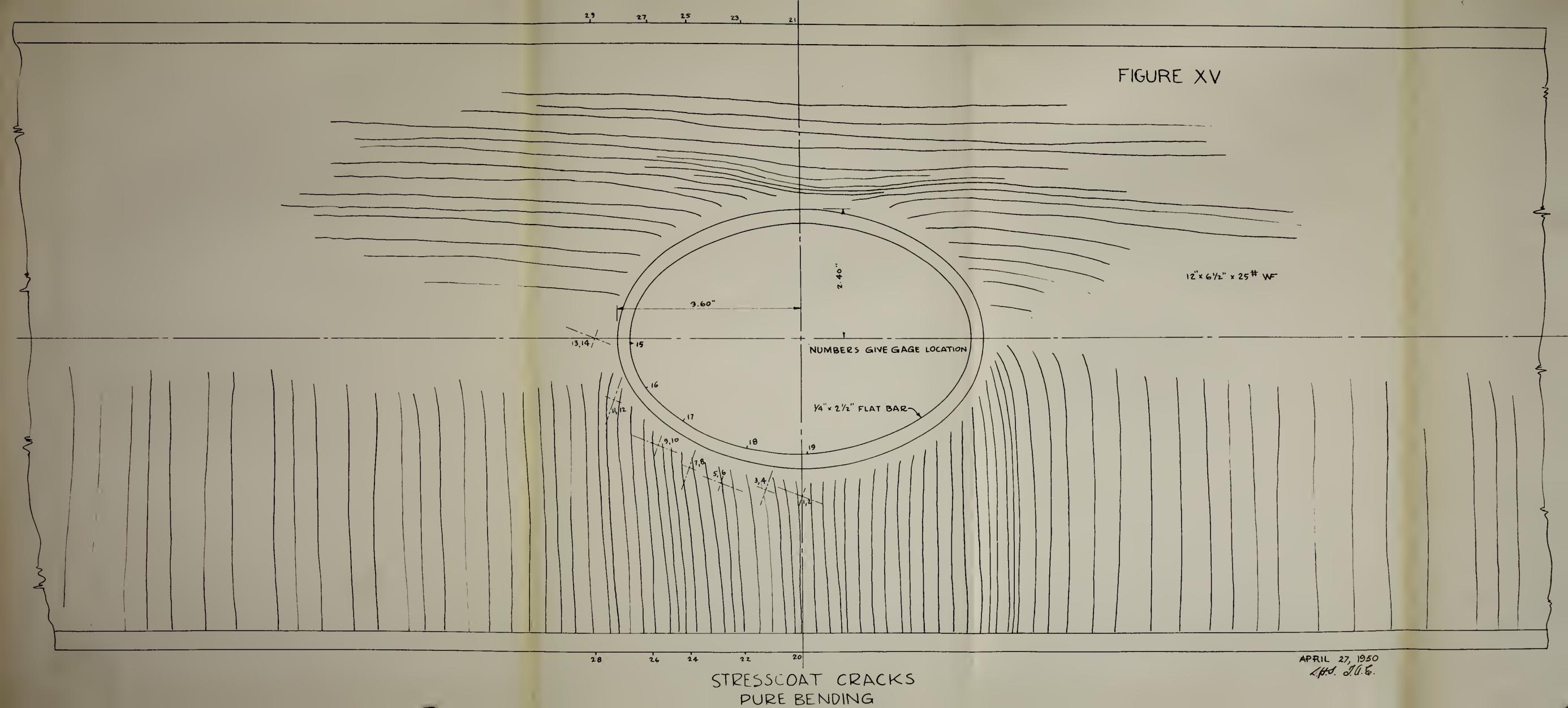
			1/0	= 0.20,	Load 37950	Lbs.		
Gage No.	€ x x106	€ xl06	degrees	#1 x106	€ 2 x106	O, psi	O (calc) psi	Stress conc. factor
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	525 550 565 558 524 402 272	-220 -138 - 62 - 34 - 40 -162 -252	10.8 80.3 5.4 88.5 0.0 83.6 36.2	553.1 570.7 570.6 558.4 524.0 409.2 876.4 52.0 577.0 837.0 702.0 347.0 753.0 700.0 670.0 660.0	-248.1 -158.7 - 67.6 - 34.4 - 40.0 -169.2 -856.4	15920 17360 18230 18140 16950 11910 20770 1470 16330 23700 19900 9820 22820 21210 20300 19910 20000	15540 15190 14710 13840 12590 10450 8123 8276 9880 11390 12670 13150 23250 22750 22290 21970 21490	1.02 1.14 1.24 1.31 1.35 1.14 2.56 .18 1.65 2.08 1.57 .75 .98 .93 .91 .91
			·1/6	æ 0.35,	Load 36885	Lbs.		
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	451 487 520 528 517 440 350	-279 -145 - 22 26 16 -184 -337	12.1 77.7 14.2 74.7 1.5 84.2 31.9	321.9 518.5 557.1 568.6 517.4 446.6 784.5 74.0 737.0 970.0 710.0 235.0 520.0 450.0 407.0 390.0 395.0	-149.9 -176.5 - 59.1 - 14.6 -15.6 -190.6 -771.5	9210 15460 17860 18670 17260 12940 18550 2092 20840 27431 20080 6645 15760 13630 12330 11820 11970	14390 14060 13730 13210 12510 11240 9866 9963 10950 11860 12641 12950 16130 15530 14960 14670 13990	.64 1.10 1.30 1.41 1.38 1.15 1.88 .21 1.90 2.32 1.59 .51 .98 .88 .83 .81



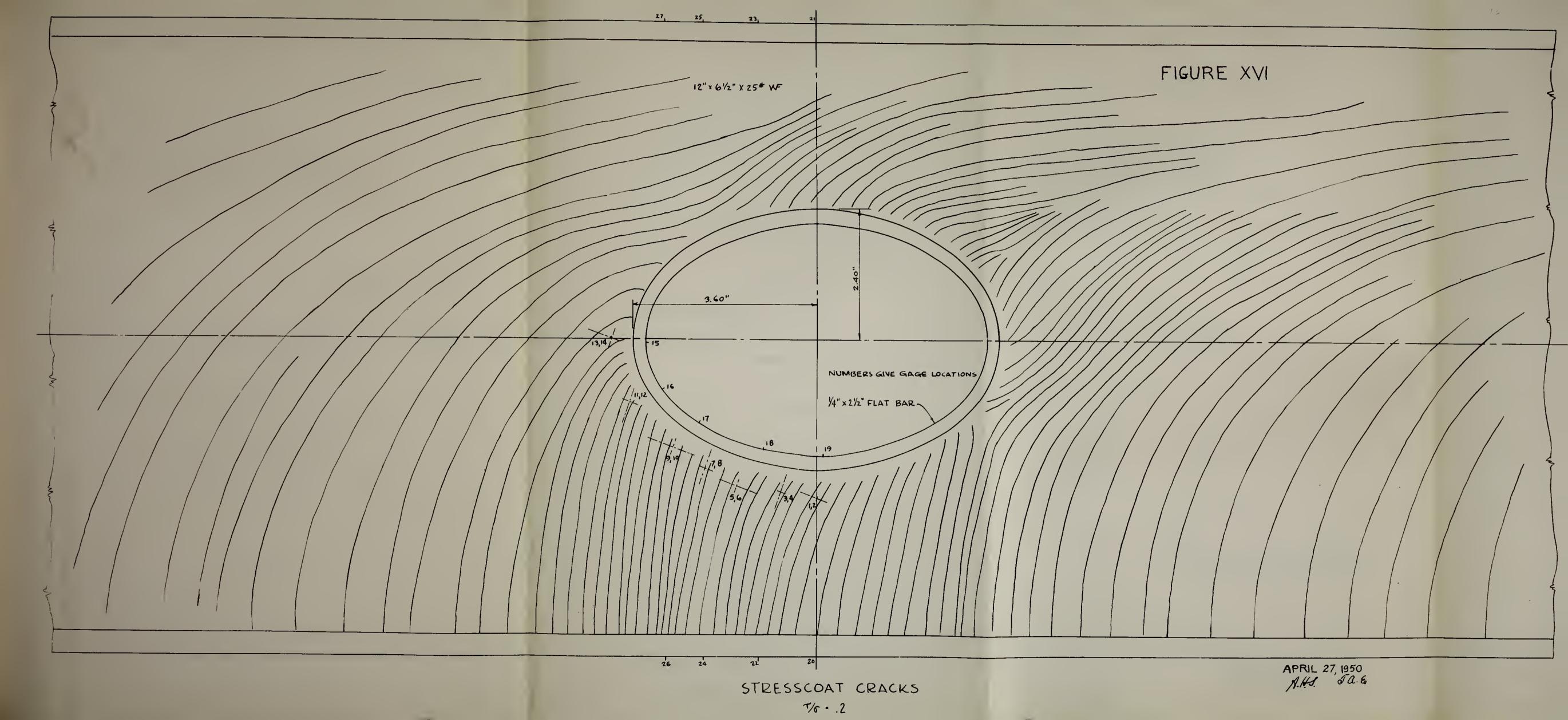
TABLE V (contid)

			,									
	7/5 = 0.50, Load 34750 Lbs.											
Gage No.	Ex xl06	€y xl06	degrees	€1 x106	€ 2 x10 <sup>6</sup>	ر ا psi	S (calc.) psi	Stress conc. factor				
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	395 437 477 492 495 440 376	-281 -142 - 11 -42 -43 -160 -362	13.5 75.1 23.0 60.9 3.0 84.7 27.6	436.3 481.1 584.3 694.0 496.2 445.2 653.6 91.0 793.0 998.0 667.0 165.0 379.0 301.0 254.0 237.0 241.0	-322.3 -186.1 -118.3 -160.0 41.8 -165.2 -639.6	11340 14130 18190 21424 16820 13140 15490 2573 22420 28220 18860 4660 11480 9120 7696 7181 7300	13320 13090 12820 12490 12030 11190 10320 10390 11040 11640 12170 12410 11820 11190 10590 10186 9580	,86 1.08 1.42 1.72 1.40 1.08 1.50 .25 2.03 2.42 1.55 .37 .97 .82 .73 .71 .76				
			Pure	Bending,	Load 4392	5 Lbs.						
1,2 3,4 5,6 7,8 9,10 11,12 13,14 15 16 17 18 19 20,21 22,23 24,25 26,27 28,29	445 336 294 290 281 178	- 35 - 45 - 50 - 50 - 46 - 22	21.4 59.0 28.1 62.0 24.4 78.0	532.1 551.3 431.2 414.9 365.7 187.5 0.0 -79.0 112.0 412.0 442.0 946.0 960.0 977.0 976.0 974.0	-122.1 -260.3 -187.2 -174.9 -130.7 - 31.5	16430 15740 12500 12050 10840 5901 0 -2230 3170 11650 12500 28660 29080 29600 29570 29510	14610 14080 13450 12120 9980 5780 387 4365 7475 9712 10420 28870 28870 28870 28870 28870 28870	1.12 1.12 .93 .99 1.09 1.02 .00 51 .42 1.20 1.20 1.20 1.01 1.03 1.02 1.02				

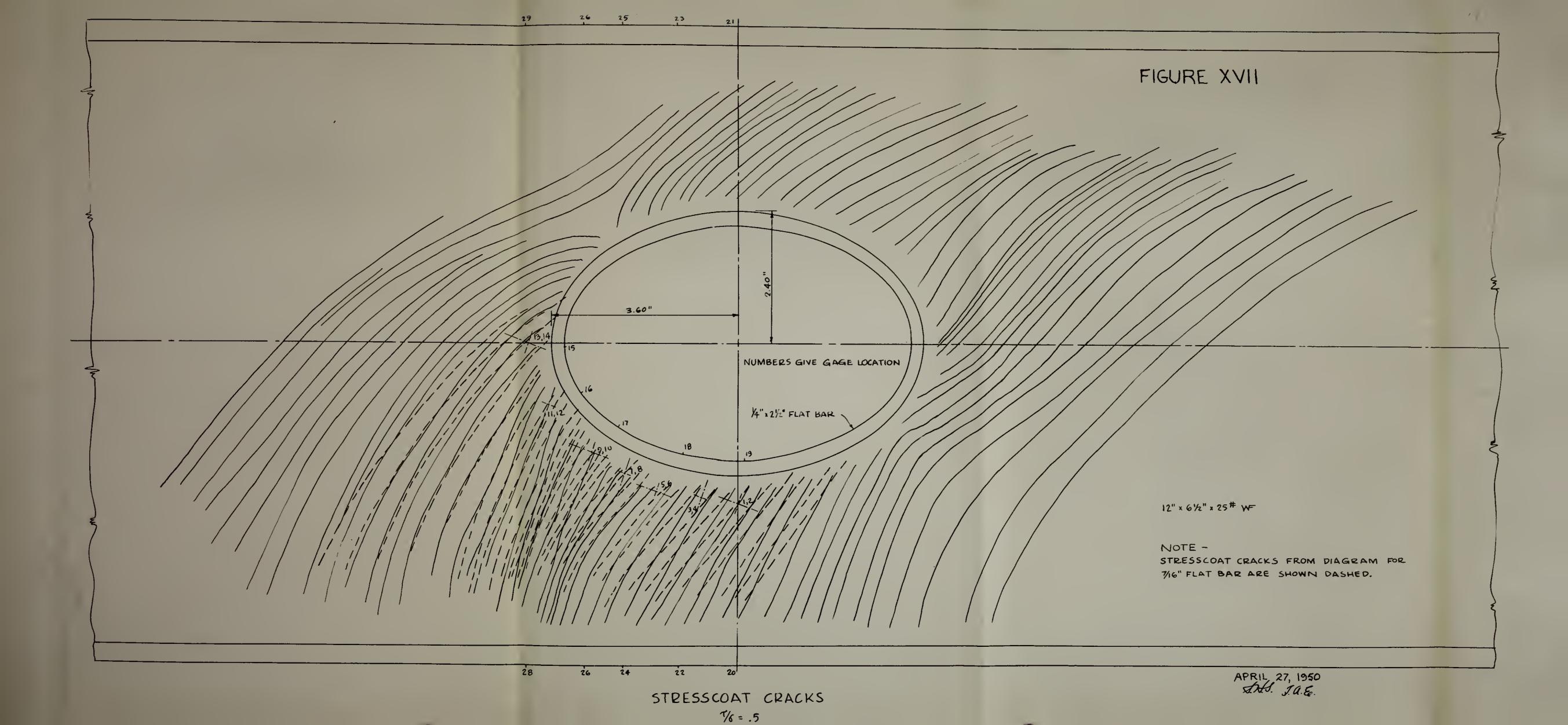














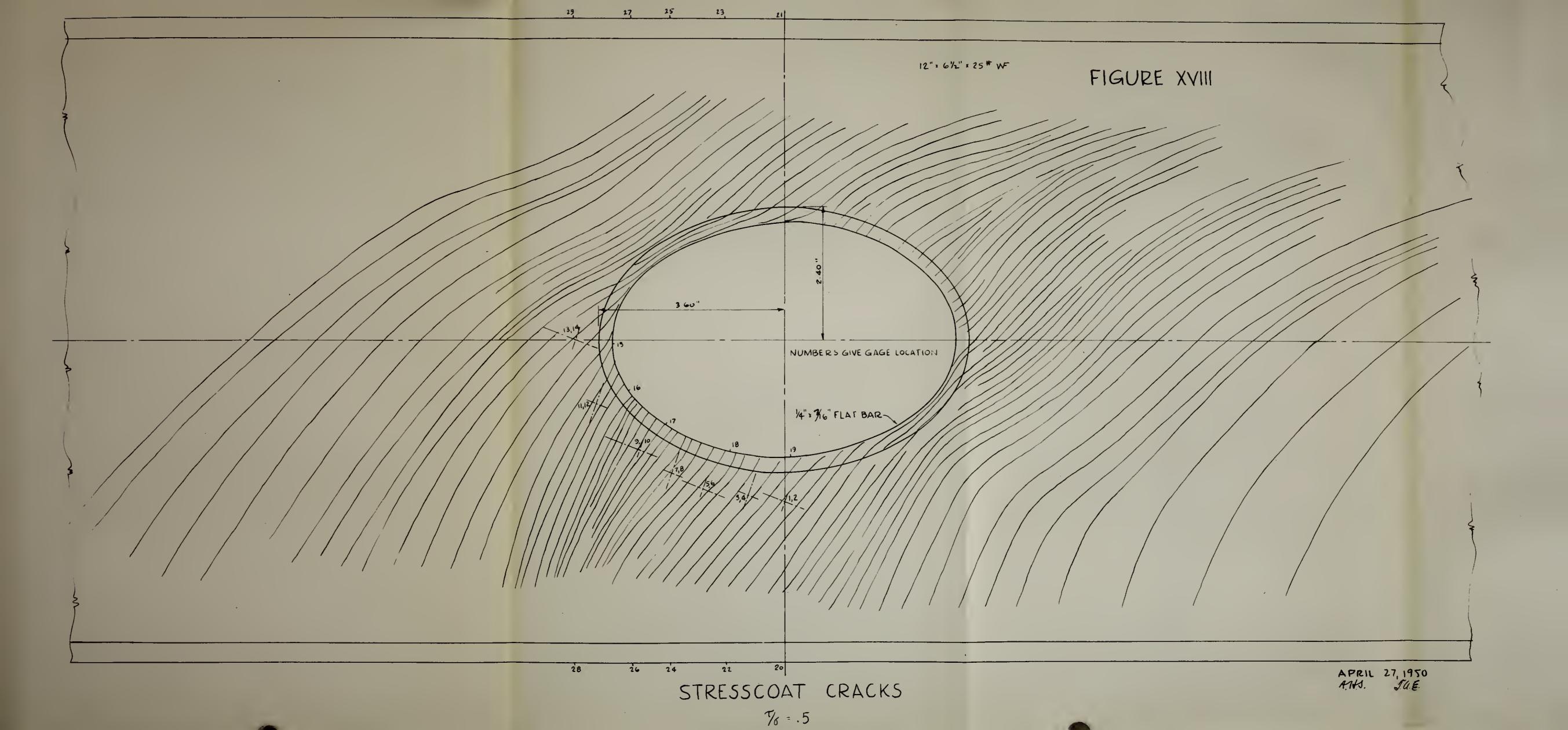
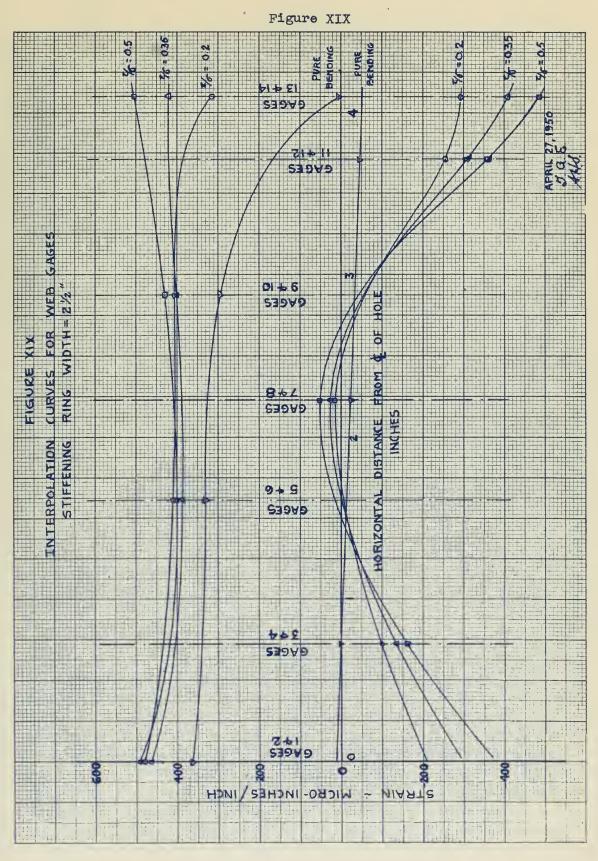




Figure XIX



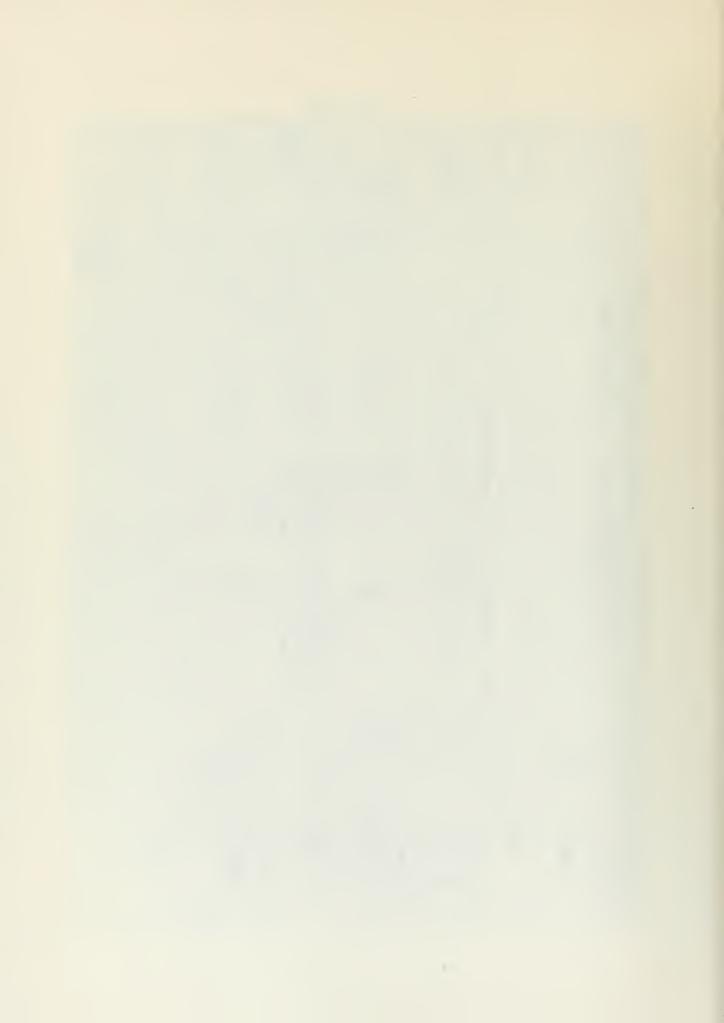


Figure XX

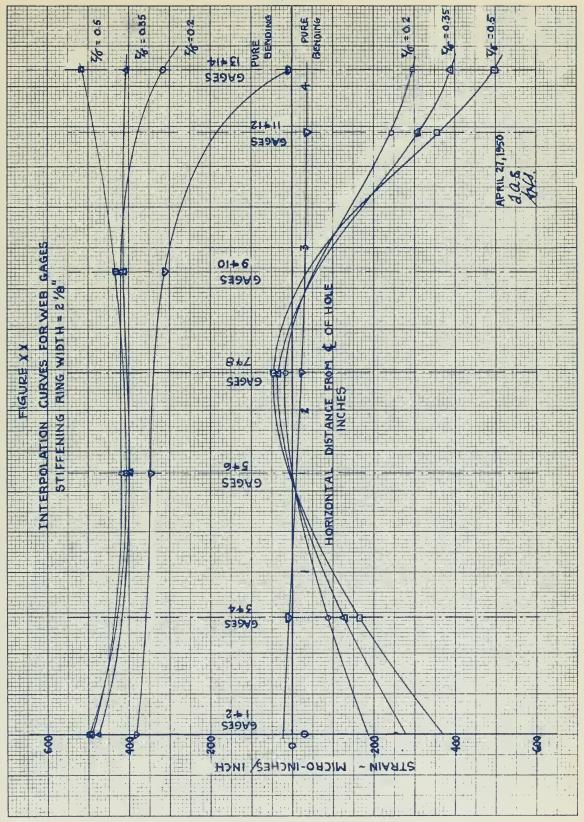




Figure XXI

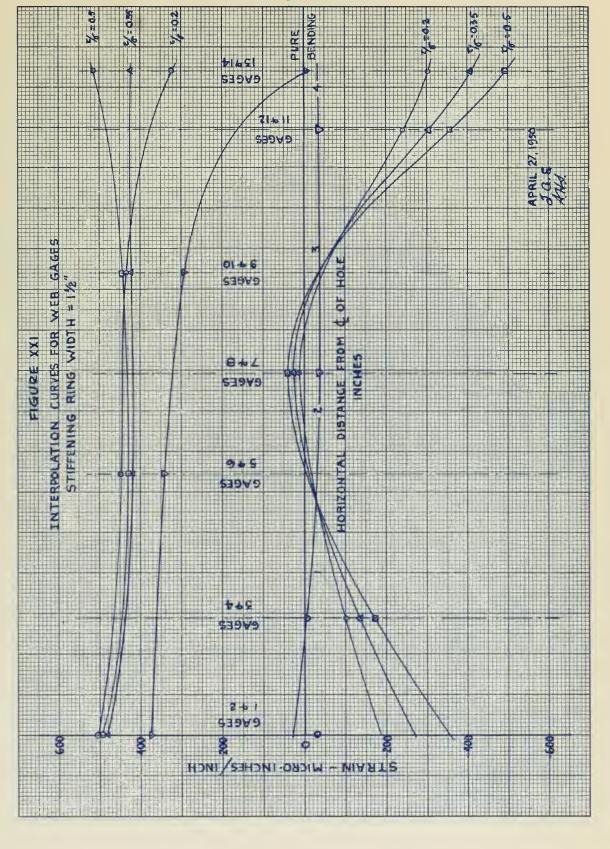




Figure XXII

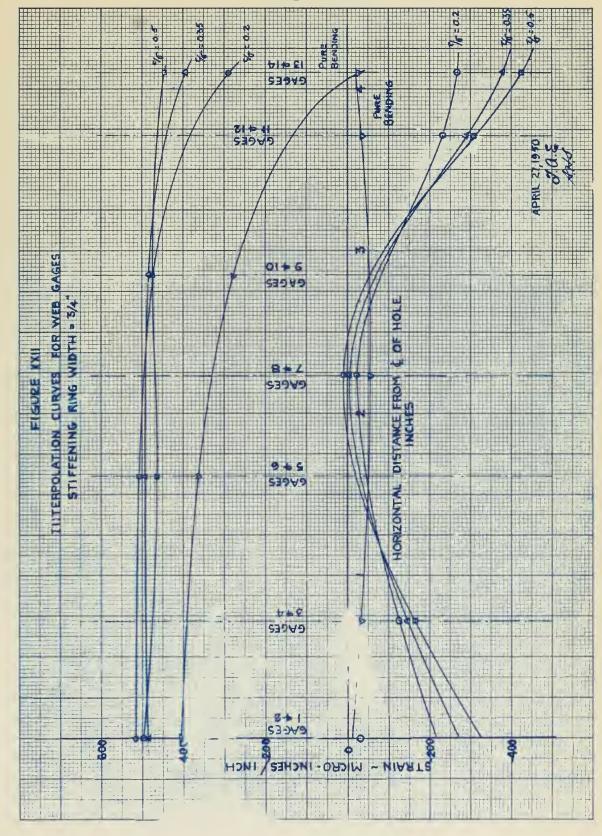
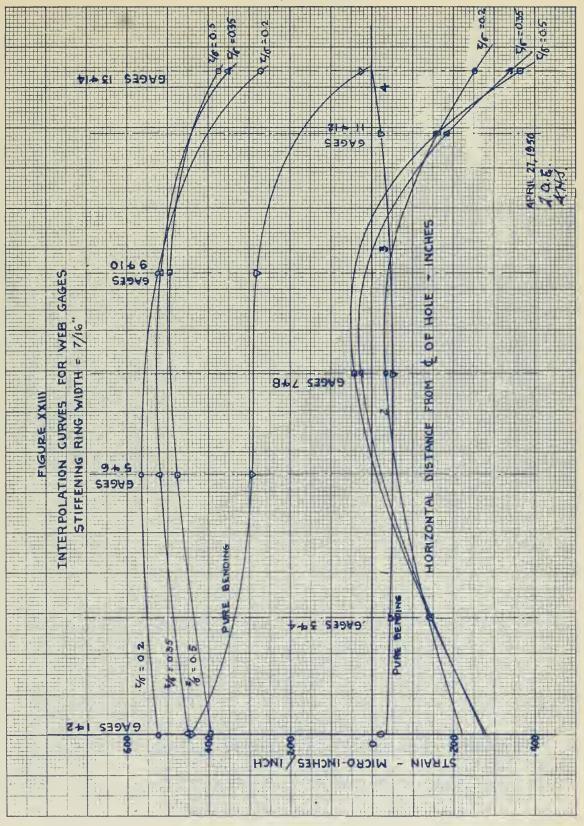


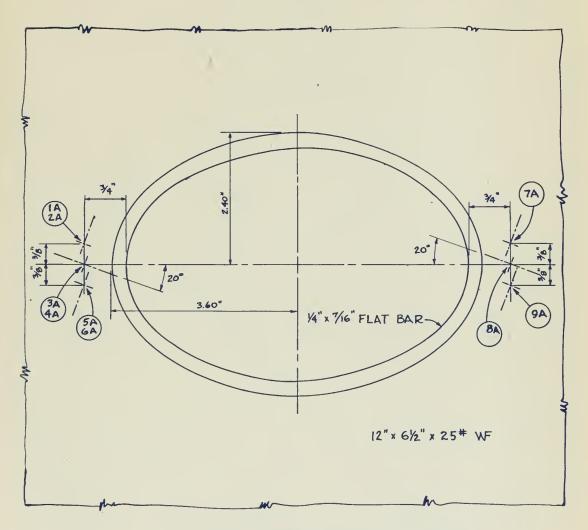


Figure XXIII





## FIGURE XXIV



LOCATION OF SUPPLEMENTARY "A" GAGES
ON WEB
GAGES 1A,3A,5A,7A, 8A,9A NEAR SIDE
GAGES 2A,4A,6A FAR SIDE

GAGES 3A, 4A SAME LOCATION AS GAGES 13, 14.

APRIL 27, 1950 MHS. d.Q.E.

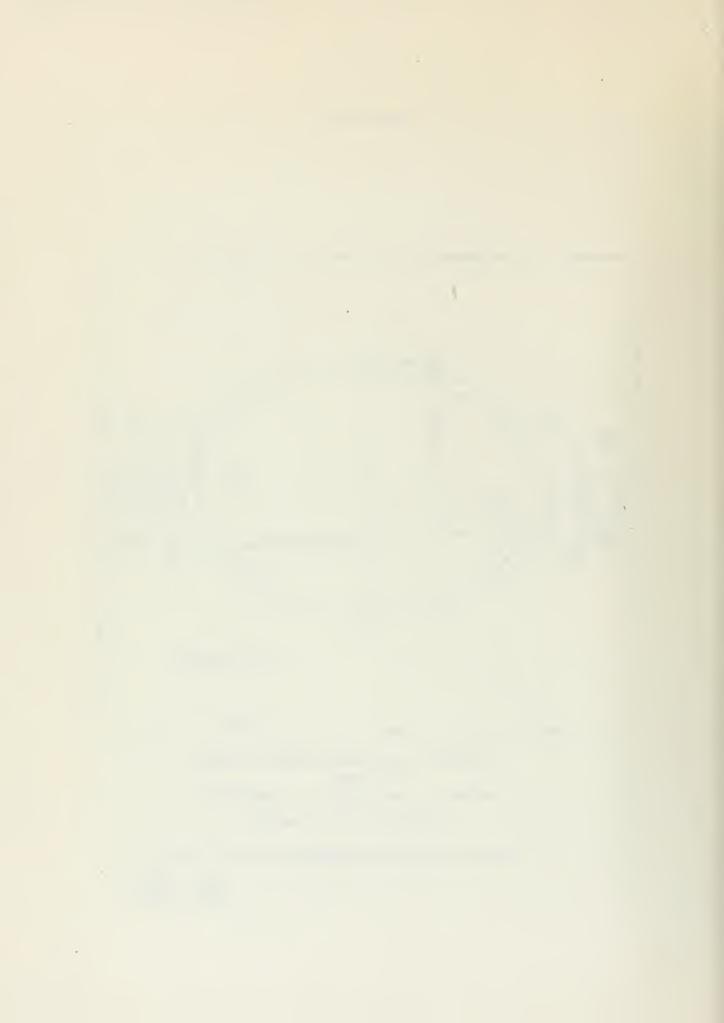
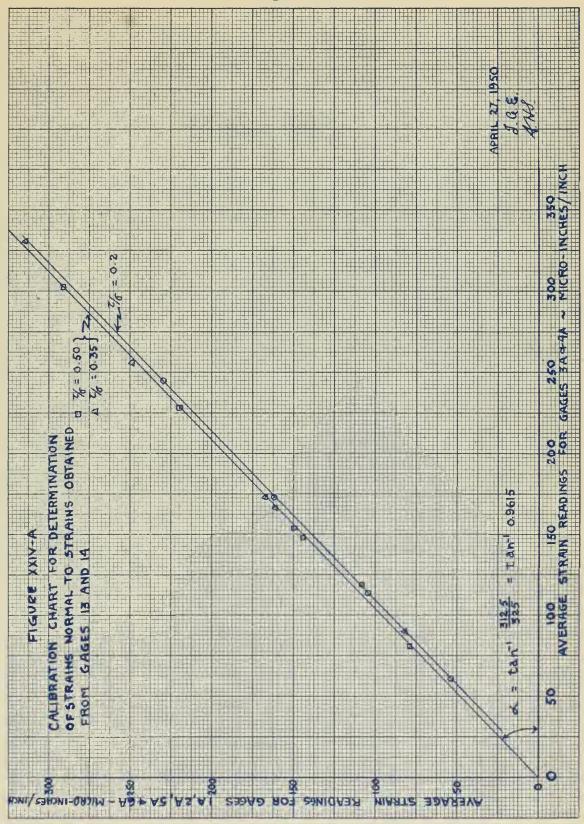


Figure XXIV -A





## APPENDIX C

## SAMPLE CALCULATIONS

In this section are examples of the calculations for gages on the web, the stiffening ring, and the flanges. Theoretical stress based upon the intact beam is calculated for each example of gage location. The method of deriving the stress from the strain gage readings is given. While the method is quite simple for the stiffening ring and flange gages, consisting merely of multiplying the observed strain by the modulus of the material, the calculation in the case of the web gages is more complicated and will be explained here.

As stated in Appendix B, Details of Procedure, it was not practicable to use rosette gages, because their size conflicted with the desire to locate the web gages as close as possible to the stiffening ring. As is seen diagrammatically from Mohr's Circle, if two stresses normal to each other

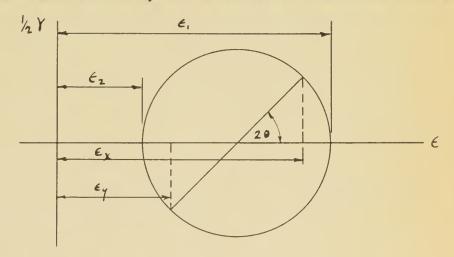


Figure XLIV - Mohr's Circle for Strain



can be measured at a given point, the principal strains can be obtained if 0 is known, according to the relations

$$\epsilon_{1} = \epsilon_{x} + \epsilon_{y} + \epsilon_{x} - \epsilon_{y}$$
 sec 29 (1)

$$\epsilon_2 = \frac{\epsilon_x + \epsilon_y}{2} - \frac{\epsilon_x - \epsilon_y}{2}$$
 sec 29 (2)

 $\theta$  is determined by the stresscoat cracks which are the orthogonal trajectories of the principal tensile strains. To determine the values of  $\theta$  for % = 0.35, linear interpolation between the values for 0.20 and 0.50 was used. It should be noted here that  $\theta$  is assumed to remain constant for various breadths of stiffening ring. As a check upon this assumption, at the conclusion of the strain measurement tests a stresscoat diagram was obtained for the  $7/16^n$  stiffening ring at % = 0.50. This is compared, in Figure XVII, with the original for the  $2\frac{1}{6}^n$  ring. Although there is some deviation between the lines, those in the vicinity of gages 13 and 14 are essentially parallel. This pair of gages is the only pair at which a high stress concentration is indicated, and the above assumption is true for them. The order of magnitude of the results for the other web gages is not altered by the fact that the assumption for them is not strictly correct. Hence in the calculations,  $\theta$  varies only with mode of loading.

With gages 1 and 2, 5 and 6, 9 and 10, and 13 and 14 oriented with their axis 20° below the horizontal, and gages 3 and 4, 7 and 8, and 11



and 12 at  $110^{\circ}$  below the horizontal, a plot of strains vs. longitudinal distance along the beam could be made for the two sets of gages which would be a fair curve. These are the Interpolation curves, Figures XIX-XXIII.  $\mathcal{E}_{\chi}$  is given by the gages at  $20^{\circ}$ , and  $\mathcal{E}_{\gamma}$  by the gages at  $110^{\circ}$ . Thus from these charts, the strain at right angles to any gage can be determined.

Having determined  $\epsilon_1$  and  $\epsilon_2$ , the principal stress,  $\delta_1$ , is obtained from the formula

$$\delta_1 = \frac{(\epsilon_1 + \mu \epsilon_2)^E}{1 - \mu^2}$$
 (3)

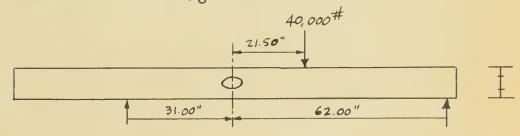
in which, from the results of the tensile test specimen, Young's modulus

$$E = 30.3 \times 10^6$$

and Poisson's ratio is assumed to be

# A. Web Gage Calculation

(1) Stress for the intact beam for gages 3 and 4 under loading condition \( \frac{7}{6} = 0.35 \)





Specifications of the intact beam:

Dimensions 12" x 6½" x 25# WT

$$I = 183.4 ins.^4$$

Depth C = 11.87"

Web thickness b = 0.24"

Average flange thickness 0.355"

Section Modulus S = 30.9 ins.3

$$M_{R_2} = 0 = 93 R_1 - 1620,000$$
 $R_1 = 17420 \#$ 

Lever = 31.00 - 0.72

= 30.28M

Moment =  $17420 \times 30.28$ 

= 540,000 in. lbs.

y = 2.90

$$6 = M_y/I = \frac{540000 \times 2.90}{183.4}$$

= 8332 psi

Longitudinal Shearing Stress = 
$$\frac{R_1 Q}{I b} = \tau_L$$
  
=  $\frac{17420 \times 25.98}{183.4 \times .24}$   
= 10270 psi.

$$\delta_{1} = \frac{\delta}{2} + \sqrt{(\frac{\sigma}{2})^{2} + \tau_{L}^{2}}$$

$$= 4166 + 10^{3} \sqrt{17.36 + 105.47}$$

$$= 15,250 \text{ psi.}$$



(2) Larived Stress From Gages 3 and 4

$$\frac{\pi}{6} = 0.35$$
, Stiffening Ring  $1\frac{1}{2}$ 

$$\epsilon_1 = \frac{\epsilon_1 + \epsilon_2}{2} + \frac{\epsilon_2 - \epsilon_3}{2}$$
 sec 20

$$\epsilon_2 = \frac{\epsilon_x + \epsilon_y}{2} - \frac{\epsilon_x - \epsilon_y}{2}$$
 sec 20

- $\epsilon_y$  = value obtained from interpolation curves, Figure XXI, lower curves for  $\tau/6$  = 0.35, at line marked mgages 3 and 4.

E = 423 micro-inches per inch

 $\epsilon_y$  = -137 micro-inches per inch

(These values appear also in Table III)

$$\frac{\epsilon_x + \epsilon_y}{2} = 143$$

$$\frac{\epsilon_{x} - \epsilon_{y}}{2} = 280$$

sec 20 = -1.0998

$$\frac{\epsilon_{x} - \epsilon_{y}}{2} \text{ sec } 2\theta = -307.9$$

$$\frac{\epsilon_{1}}{1} = 143 + (-307.9)$$

$$= -164.9 \text{ micro-inc. per in.}$$

$$\frac{\epsilon_{2}}{2} = 143 - (-307.9)$$

$$= 450.9 \text{ micro-in. per in.}$$

$$\frac{\delta_{1}}{1} = \frac{(\epsilon_{max} + \mu \epsilon_{min}) E}{1 - 2}$$

$$\mu = .29$$

$$\frac{E}{1 - \mu 2} = 33.082 \times 10^{6}$$

$$\epsilon_{max} + \mu \epsilon_{min} = 403.1$$

$$\delta_{1} = 403.1 \times 33.082$$

$$= 13330 \text{ psi}$$

(3) Calculation of stress concentration factor:

Stress concentration factor is defined as
the ratio of the derived stress to the
calculated stress.

Factor = 
$$\frac{13330}{15250}$$
  
= 0.87



## B. Stiffening Ring Gage Calculation

(1) Derived Stress

$$\frac{7}{6} = 0.35$$
, Stifening Ring  $1\frac{1}{2}$ 

Gage No. 17

Load 39,945 Lbs.

= 694 micro-inches per inch

$$E = 29.28 \times 10^6 \text{ psi}$$

= 19630 psi.

(2) Calculated stress is obtained in a manner similar to the web gage.

Calculated stress = 12860 psi.

(3) Stress concentration factor =  $\frac{19630}{12360}$ 

Factor = 1.53

# C. Flange Gage Calculation

(1)  $\frac{7}{6} = 0.35$ , Stiffening Ring  $\frac{1}{2}$ 

Gage Nos. 20 and 21

Load 39,945 Lbs.

= 564 micro-inches per inch

$$E = 30.3 \times 10^6 \text{ psi.}$$

$$= 30.3 \times 10^6 \times 564 \times 10^{-6}$$

= 17090 psi.

## (2) Calculated Stress

$$S = 30.9 ins.^3$$

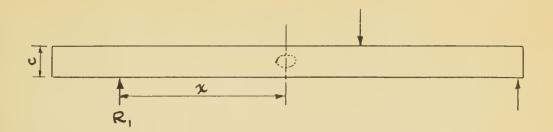
$$\delta_{c} = \frac{M}{S}$$

= 17500 psi.

# (3) Stress Concentration Factor = 0.98



#### D. Calculation for the Loading Condition



$$\delta = \frac{Mc}{2I}$$

$$\tau = \frac{V}{tc} = \frac{R_1}{tc}$$

$$\tau_{\delta} = \frac{2RI}{Mc^2t}$$

but 
$$M = R_1 x$$
hence  $\frac{7}{6} = \frac{2 I}{x t c^2}$ 

for any beam  $\frac{2}{t} = a$  constant, K

then 
$$\frac{\tau}{\sqrt{z}} = \frac{\kappa}{\kappa}$$

$$x = K\left(\frac{1}{\tau/\sigma}\right)$$

and K for the beam =  $\frac{2 \times 183.4}{.24 (11.87)^2}$ 



Hence x for 
$$\frac{7}{6}$$
 = .35 becomes

$$\chi_{.35} = \frac{10.85}{.35}$$

### E. Stress Concentration Factor At Gage 8A

Using Values from Figure XXV

Using Values from Figure XXV

(1) 
$$\mathcal{C}_{x} = 0.50$$
 $\mathcal{C}_{x} = 345 \text{ micro-inches per inch (gase 8A)}$ 
 $\mathcal{C}_{y} = -315 \text{ micro-inches per inch (average, gages 7A and 9A)}$ 
 $\frac{\mathcal{C}_{x} + \mathcal{C}_{y}}{2} = 15 = D$ 
 $\frac{\mathcal{C}_{x} - \mathcal{C}_{y}}{2} = 330 = E_{1}$ 
 $2\theta = 49.0^{\circ}$ 

Sec 
$$2\theta = 1.5243$$

$$E_1$$
 Sec 20 = 503.0 = H

$$\epsilon_1 = D + H = 545.0$$

$$\delta_1 = \frac{(\epsilon_1 + \mu \epsilon_2) E}{1 - \mu^2}$$

$$E = 30.3 \times 10^6$$

$$\frac{E}{1 - \mu^2} = 33.0^{\circ}2 \times 10^6$$

$$\epsilon_1 + \mu \epsilon_2 = 545.0 - 141.5$$

= 403.5 micro-inches per in.

= 13350 psi

Calculated Stress  $G_c = 10260$  psi.

Stress Concentration Factor =  $\frac{G_1}{G_c}$ = 1.30

(2) 
$$\frac{7}{6} = 0.20$$

 $\epsilon_{x}$  = 293 micro-inches per inch (Gage 8A)

 $\epsilon_y = -248$  micro-inches per inch (average, gages 7A and 9A)

$$\frac{\epsilon_{x} + \epsilon_{y}}{2} = 22.5 = D$$

$$\frac{\epsilon_{x} - \epsilon_{y}}{2} = 270 = E_{1}$$

Sec 28 = 2.790

$$\frac{\epsilon_{x} - \epsilon_{y}}{2} \sec 2\theta = 754.7 = H$$

$$\epsilon_{1} = D + H = 777.2$$

$$\epsilon_{2} = D - H = -732.2$$

$$\delta_{1} = \frac{(\epsilon_{1} + \mu \epsilon_{2}) E}{1 - \mu^{2}}$$

$$\mu = .29$$

$$\frac{E}{1 - \mu^{2}} = 33.082 \times 10^{6} \text{ where } E = 30.3 \times 10^{6}$$

$$\epsilon_{1} + \mu \epsilon_{2} = 777.2 + .29(-732.2)$$

$$= 564.9 \text{ micro-inches per inch}$$

$$\delta_{1} = 564.9 \times 33.032$$

$$= 13.690 \text{ psi.}$$

Calculated stress 
$$G_c$$
; 8120 psi

Stress Concentration Factor =  $\frac{G_1}{G_c}$ 

= 2.30

TABLE XII

# VALUES OF STRAIRS FORMAL TO STRAINS FOR GAGES 13 AND 14 FOR VARIOUS BREADTHS OF STIFFFHING RING

	7	/s = 0	.20	7	σ = 0.3	5	7/	σ = 0.	50
Stiffening Ring Breadth	x10 <sup>6</sup>	K	xlo <sup>6</sup>	x x10 <sup>6</sup>	K	у x10 <sup>6</sup>	x xlo <sup>6</sup>	К	у x10 <sup>6</sup>
2½n	315	0.9615	-293	425	0.9615	-409	505	.9615	-436
2 1/8"	317		-295	405		<b>-3</b> °9	518		-498
12 "	323		-301	423		-407	515		-495
3/4 <sup>n</sup>	290		-269	394		-379	443		-426
7/16"	272		-252	350	1	-337	376	+	-362

K = Slope of Strain vs. Strain line
from Figure XXIV-A

$$\epsilon_y = -K \epsilon_x$$
 for  $\frac{7}{8} = 0.35$  and 0.50

$$\epsilon_{y} = -K \epsilon_{x} + 10 \text{ for } \% = 0.20$$

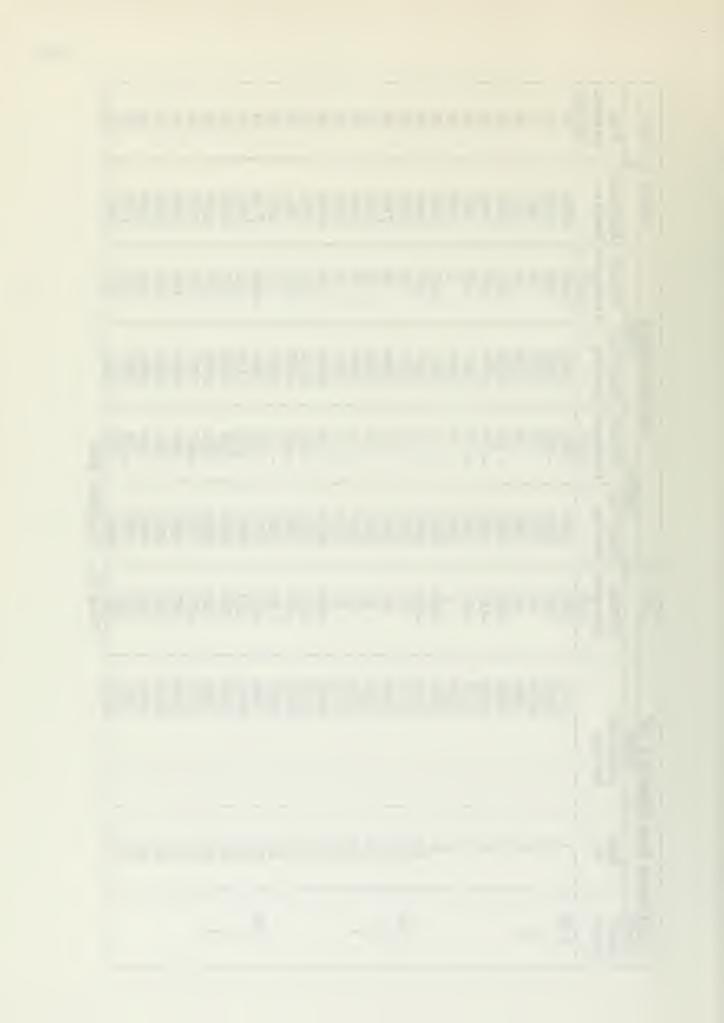
APPENDIX D

ORIGINAL DATA



Stiffen	Stiffening Ring 1	adth =	23"	0 ≈ 9/	2,	Load	Increa	20	March 22,	3 1950
Load		0	1 91	00	18000	00	22000	00	3774	2
Gage	99්සව	Indicator	or	Strain	Indicator	Strain	Indicator	Strain	Indicator	Strain
Factor	No.	Reading		Increment x106	Reading	Increment	Reading	Increment x106	Reading	Increment
1,80	H	1 8684	5000	102	5110	110	5210	110	5338	118
_	2	5130	5255	1.25	5378	123	5500	122	5650	150
>	3	4546	4544	- 02	4525	- 19	4507	81	0644	- 17
	14	5360	5312	1 48	5285	- 27	5255	- 30	5220	30
	5	4655	4750	95	5484	95	4938	93	5050	112
	9	4430	4533	103	4694	101	4733	66	4855	122
	2	5510	5533	23	5543	10	5552	60	5565	13
	ထ	5342	5322	- 20	5320	- 02	5313	- 07	5310	03
	0,	5483	5580	97	5680	100	5780	100	2900	120
	10	2044	5139	95	5233	76	5325	92	2440	115
1,82	דד	0649	0449	- 50	6329	- 61	6315	179 -	6242	- 73
_	12	7295	7220	- 75	7163	- 57	7104	- 59	7033	- 71
<b>-</b>	13	6813	6885	72	6958	23	7030	72	7120	96
	14	6975	7055	80	7132	77	7208	92	7300	95
	15	6524	6540	16	6554	14	6568	14	6586	18
	16	6325	6427	102	6525	98	6623	98	6743	120
	12	5912	2409	130	6170	128	6295	125	0549	155
	18	0719	6247	107	6352	105	9549	104	6585	129
	19	5840	5893	53	2465	25	0009	53	0209	20
1.76	20	7105	7280	175	7455	175	7625	170	7833	208
_	77	7328	7148	-170	4269	-174	0089	-174	6590	-210
>	22	6575	6737	162	2689	170	7055	158	7248	193
	23	2600	5414	-186	5245	-169	5080	-165	0884	-200
	ঠ	7105	7265	160	7425	160	7587	162	7780	193
	25	6250	0809	-170	5920	-160	5763	-157	5573	-190
	92	0649	6587	157	6743	156	9689	153	7084	188
	27	6374	6220	-154	6909	-157	5905	-158	5720	-185
	82	7054	7220	991	7365	145	7520	155	2204	184
	59	4299	6510	-164	6352	-158	6192	-160	6009	189
				Table VI	. Original	. Data				

or         Strain         Indicator         Indicator         Strain         Indicator         Strain         Indicator         Indicator         Strain         Indicator         Holo         4900							0	0	יאינה בווי בייני	0 4/10
No.   Reading   Indicator   Strain   Indicator   Indica	Load		27000		1800	00	9100	)	0	
No.   Reading   Increment   Reading   Increment   Reading   Increment   Incr	Ове	Gage	Indicator	Strain	Indicator	Strain	Indicator,	Strain	Indicator	From
Section	Factor	No.	Reading	Increment x106		Increment x106	Reading	Increment x106	Reading	Original Reading
2 4510 -140 5390 -120 5261 -129 5261 -129 5260	۰	7	5223	-115	5122	-101	5010	-112	00647	02
10   10   10   10   10   10   10   10	_	2	5510	-140	5390	-120	5261	-129	5132	02
		<u></u>	4510	20	4530	8	4550	20	4551	05
10	<b></b> 4-	4	5260	\$	5292	32	5320	28	5367	20
6		~	14950	-100	0984	06 -	4759	-101	0994	05
7 5552 - 13 5542 - 10 5540 - 02  8 5316 6 5322 6 5325 3  10 5340 -108 5549 - 95 5550 -107  10 5340 -108 5549 - 91 5147 -102  11 7102 6955 - 71 6444 69  12 7036 - 93 6965 - 71 6890 - 75  13 7036 - 93 6965 - 71 6890 - 75  14 7712 - 88 7136 - 75 7060 - 76  15 6625 - 118 6183 - 124 6050 - 133  16 6625 - 118 6183 - 124 6050 - 133  17 6625 - 118 6183 - 124 6050 - 135  18 6475 - 103 6257 - 113  22 776 20 7645 - 188 7475 - 170 729 - 135  24 7610 - 170 7453 - 157 7278 - 173  25 5760 - 187 5920 - 160 6082 - 169  26 6920 - 164 6769 - 151 6600 - 169  27 5900 - 164 6769 - 151 6600 - 169  28 7540 - 164 7390 - 160 6515 - 165  29 7550 - 164 6769 - 151 6600 - 169  20 7550 - 164 6769 - 151 6600 - 169  20 7550 - 164 6769 - 151 6600 - 169  20 7550 - 164 6769 - 151 6600 - 169  21 6750 - 164 6769 - 151 6600 - 169  22 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7		9	5424	-110	1825	- 98	4540	-107	454	70
82 11		2	5552	- 13	5542	- 10	5540	- 02	5515	9
9 5792 -108 5697 - 95 5590 -107  10 5340 -100 5249 - 91 5147 -102  11 7102 69 7165 61 6444 69  12 7036 - 93 6965 - 71 6890 - 75  13 7036 - 93 6965 - 71 6890 - 75  14 7212 - 88 7136 - 75 7060 - 76  15 6625 - 18 6530 - 95 6430 - 104  16 6625 - 10 6534 - 124 6050 - 133  17 622 - 10 6372 - 103 6257 - 115  22 7076 - 172 6920 - 153 5904 - 153  23 7076 - 172 6920 - 153 5904 - 173  24 7610 - 172 6920 - 157 7154 181  25 5760 187 5920 160 6082 165  26 6620 - 164 6769 - 151 6600 - 169  27 5900 - 164 6769 - 151 6600 - 169  28 7540 - 164 6769 - 151 6600 - 169  29 6190 187 6350 - 160 6523 - 165  20 7540 - 164 7390 - 150 6523 - 165  20 7540 - 164 7390 - 160 6523 - 165  20 7540 - 164 7390 - 160 6523 - 165  20 7540 - 164 7390 - 160 6523 - 160 6523 - 160 6523 - 160 6533 - 160 6533 - 160 6533 - 160 6533 - 160 6533 - 160 6533 - 160 6533 - 160 6533 - 160 6533 - 160 6533 - 160 6533 - 160 6533 - 160 6533 - 16		∞	5316	9	5322	9	5325	3	5348	90
10 5340 -100 5249 - 91 5147 -102 514		6	5792	-108	5697	- 95	5590	-107	5485	02
12   6314   82   6375   61   6444   69     13   7036   -93   6965   -71   6890   -75     14   7212   -88   7136   -75   7224   59     15   6566   -20   6554   -12   6540   -14     16   6625   -118   6530   -124   6050   -133     18   6020   -143   6183   -124   6050   -133     19   6020   -50   5967   -13   6257   -115     22   7076   -188   7475   -103   6257   -115     24   7610   -172   6920   -156   6600   -169     25   5760   187   5920   160   6600   -169     26   6920   -164   6769   -151   6600   -169     27   7540   -164   7390   -150   6515   -165     28   7540   -164   7390   -150   6515   -165     29   7540   -164   7390   -150   6515   -165     20   7225   -165   -166   -166     20   7225   -165   -166     20   7225   -165   -166     20   7225   -165   -166     20   7225   -165   -166     20   7225   -165     20   7225   -		10	5340	-100	5249	- 91	5147	-102	2047	03
12       7102       69       7165       63       7224       59         13       7212       - 88       7136       - 75       7060       - 75         14       6566       - 20       6554       - 12       6540       - 14         15       6625       - 18       7136       - 75       7060       - 76         16       6625       - 18       6730       - 124       6690       - 14         17       6625       - 19       6530       - 124       6690       - 10         18       6475       - 110       6572       - 124       6050       - 133         20       7645       - 10       6372       - 124       6050       - 133         21       6620       - 50       5967       - 53       5904       - 63         22       7645       - 18       7475       - 173       7154       181         23       5075       195       5246       171       5420       174         24       7610       - 170       7453       - 157       7278       175         25       5760       180       6060       - 150       6600       - 169	1.82	11	6314	82	6375	19	14149	69	2649	00
13       7036       - 93       6965       - 71       6890       - 75         14       7212       - 88       7136       - 75       7060       - 76         15       6626       - 20       6554       - 12       6540       - 14         16       6626       - 118       6530       - 95       6430       - 100         17       6307       - 119       6372       - 124       6050       - 133         18       6426       - 50       5967       - 53       5904       - 63         20       6420       - 50       5967       - 53       5904       - 63         21       6800       173       6973       173       6973       - 173         22       7645       - 172       6920       - 156       6747       - 173         23       5075       - 172       6920       - 156       6747       - 173         24       7610       - 170       7453       - 157       6700       - 169         25       5900       - 180       6060       - 160       6060       - 160       6060       - 160       6060       - 160       - 151       600       - 169	2.5	12	7102	69	7165	63	7224	59	7302	20
14       7212       - 88       7136       - 75       7060       - 76         15       6566       - 20       6554       - 12       6540       - 14         16       6625       - 118       6530       - 95       6430       - 10         17       6307       - 143       6183       - 124       6050       - 13         18       6475       - 110       6372       - 103       6257       - 113         19       6020       - 50       5967       - 53       5904       - 63         20       7645       - 103       6257       - 115       625       - 115         21       6800       173       6973       - 179       7290       - 183         22       7645       - 172       6920       - 156       6747       - 173         23       5075       195       5246       171       5420       174         24       7610       - 170       7453       - 157       6600       - 169         25       5900       180       6060       - 164       6769       - 151       6600       - 169         28       7540       - 164       7390 <t< td=""><td></td><td>13</td><td>9602</td><td>- 93</td><td>6969</td><td>- 71</td><td>0689</td><td>- 75</td><td>6818</td><td>05</td></t<>		13	9602	- 93	6969	- 71	0689	- 75	6818	05
15       6566       - 20       6554       - 12       6540       - 14         16       6625       -118       6530       - 95       6430       - 100         17       6307       -143       6183       - 124       6050       - 133         18       6475       -110       6372       - 103       6257       - 115         20       7645       -18       7475       - 170       7290       - 185         21       6800       173       6973       173       7290       - 185         22       7645       -172       6920       - 156       6747       - 173         23       5075       195       5246       171       5420       - 173         24       7610       - 172       6920       - 157       7278       - 173         25       5760       187       6769       - 157       6789       - 169         26       6920       - 164       6769       - 151       6600       - 169         27       5900       180       6060       160       6515       - 165         28       7540       - 164       7390       - 160       6515 <td< td=""><td>-</td><td>77</td><td>7212</td><td>- 88</td><td>7136</td><td>- 75</td><td>2060</td><td>- 76</td><td>6980</td><td>05</td></td<>	-	77	7212	- 88	7136	- 75	2060	- 76	6980	05
16       6625       -118       6530       -95       6430       -100         17       6307       -143       6183       -124       6050       -133         18       6475       -110       6372       -103       6257       -115         19       6020       - 50       5967       - 63       5904       - 63         20       7645       -18       7475       -170       7290       -185         21       6800       173       6973       173       7154       181         22       7076       -172       6920       -156       6747       -173         23       5075       195       5246       171       5420       173         24       7610       -170       7453       -157       7278       -175         25       5760       187       6769       -151       6600       -169         26       6920       -164       6769       -151       6600       -169         27       5900       180       6060       160       6223       163         29       6190       187       7390       -150       6515       -165 <t< td=""><td></td><td>15</td><td>9959</td><td>- 20</td><td>6554</td><td>- 12</td><td>0459</td><td>- 14</td><td>6530</td><td>90</td></t<>		15	9959	- 20	6554	- 12	0459	- 14	6530	90
17       6307       -143       6183       -124       6050       -133         18       6475       -110       6372       -103       6257       -115         20       7645       -130       6257       -115       6257       -115         20       7645       -188       7475       -73       5904       -63         21       6800       173       7290       -185         22       7076       -172       6920       -156       6747       -173         23       5075       195       5246       171       5420       174         24       7610       -172       7453       -157       7278       -175         25       5760       187       5920       160       6082       162         26       6920       -164       6769       -151       6600       -169         27       5900       -164       6769       -151       6600       -169         28       7540       -164       7390       -150       6515       -165         29       6190       -164       7390       -150       6515       -165		91	6625	-118	6530	- 95	96430	-100	6330	05
18       6475       -110       6372       -103       6257       -115         19       6020       - 50       5967       - 53       5904       - 63         20       7645       -188       7475       -170       7290       -185         21       6800       173       6973       173       7154       181         22       7076       -172       6920       -156       6747       -173         23       5075       195       5246       171       5420       174         24       7610       -170       7453       -157       7278       -175         25       5760       187       5920       160       6082       162         26       6920       -164       6769       -151       6600       -169         27       5900       -164       6769       -151       6600       -169         28       7540       -164       7390       -150       6515       -165         29       6190       187       6350       160       6515       165		17	6307	-143	6183	-124	6050	-133	5920	80
19       6020       - 50       5967       - 53       5904       - 63         20       7645       -188       7475       -170       7290       -185         21       6800       173       6973       173       7154       181         22       7076       -172       6920       -156       6747       -173         23       5075       195       5246       171       5420       174         24       7610       -170       7453       -157       7278       -175         25       5760       187       5920       160       6082       162         26       6920       -164       6769       -151       6600       -169         27       5900       180       6060       160       6223       163         28       7540       -164       7390       -150       6515       165         29       6190       187       6350       160       6515       165		18	5249	-110	6372	-103	6257	-115	6145	05
20       7645       -188       7475       -170       7290       -185         21       6800       173       6973       173       7154       181         22       7076       -172       6920       -156       6747       -173         23       5075       195       5246       171       5420       174         24       7610       -170       7453       -157       7278       -175         25       5760       187       5920       160       6082       162         26       6920       -164       6769       -151       6600       -169         27       5900       180       6060       160       6223       163         28       7540       -164       7390       -150       6515       165         29       6190       187       6350       160       6515       165		19	6020	- 50	5967	- 53	5904	- 63	5845	95
6800 173 6973 173 7154 181 7076 -172 6920 -156 6747 -173 5075 195 5246 171 5420 174 7610 -170 7453 -157 7278 -175 5760 187 5920 160 6082 162 6920 -164 6769 -151 6600 -169 5900 180 6060 160 6223 163 7540 -164 7390 -150 6223 163 6190 187 6350 160 6515 165	1.76	20	5492	-188	2475	-170	7290	-185	7104	- 01
7076       -172       6920       -156       6747       -173         5075       195       5246       171       5420       174         7610       -170       7453       -157       7278       -175         5760       187       5920       160       6082       162         6920       -164       6769       -151       6600       -169         5900       180       6060       160       6223       163         7540       -164       7390       -150       7225       -165         6190       187       6350       160       6515       165	-	21	0089	173	6973	173	7154	181	7335	20
5075     195     5246     171     5420     174       7610     -170     7453     -157     7278     -175       7610     -170     7453     -157     7278     -175       5760     187     5920     160     6082     162       6920     -164     6769     -151     6600     -169       5900     180     6060     160     6223     163       7540     -164     7390     -150     7225     -165       6190     187     6350     160     6515     165		22	9202	-172	6920	-156	2429	-173	6576	01
7610         -170         7453         -157         7278         -175           5760         187         5920         160         6082         162           6920         -164         6769         -151         6600         -169           5900         180         6060         160         6223         163           7540         -164         7390         -150         7225         -165           6190         187         6350         160         6515         165	-	23	5075	195	5246	171	5450	124	8655	- 02
5760         187         5920         160         6082         162           6920         -164         6769         -151         6600         -169           5900         180         6060         160         6223         163           7540         -164         7390         -150         7225         -165           6190         187         6350         160         6515         165		<del>1</del> 72	7610	-170	7453	-157	7278	-175	7107	05
6920         -164         6769         -151         6600         -169           5900         180         6060         160         6223         163           7540         -164         7390         -150         7225         -165           6190         187         6350         160         6515         165		25	5760	187	5920	160	6082	162	6779	- 01
5900         180         6060         160         6223         163           7540         -164         7390         -150         7225         -165           6190         187         6350         160         6515         165		92	6920	-164	6929	-151	0099	-169	0649	00
7540 -164 7390 -150 7225 -165 6190 187 6350 160 6515 1.65		27	9065	180	0909	160	6223	163	6386	12
6190 187 6350 160 6515 1.65		88	7540	-164	7390	-150	7225	-165	2060	90
		29	6190	187	6350	160	6515	165	6682	90



1.82   1.05   1.00	Load		0	10000	0	2000(	0	30000	00	0004	0
No.   Reading   Increment	Gage	Gage	Indicat	tor	Strain	Indicator	Strain	Indicator	Strain	Indicator	Strain
.80         1         4902         5000         96         5104         104         5299         105         5310           2         5356         5286         133         5400         132         5588         126         5655           4         5366         5292         -74         5250         -42         5404         -26         4479         -26         4479         -26         4479         -26         4479         -26         4479         -26         4479         -26         4479         -26         4479         -46         5270         -40         5171         5270         -40         5171         -26         4479         -26         4479         -26         4479         -26         4648         102         5400         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171         -40         5171	Factor	No.	Reading	60	Increment x106	Reading	Increment x106	Reading	Increment x106		Increment x106
2 5135 5266 133 5400 132 5528 126 5655  4 5366 4478 88 4639 - 25 44504 - 26 4478  5 44514 4555 - 74 5290 - 25 5100 - 40 5110  6 4478 88 4639 - 74 5250 - 74 5210 - 40 5111  6 4478 5310 - 39 5269 - 1 5300 - 9 5111  8 5346 5384 102 5685 101 5787 102 5888  10 5048 5310 - 39 5389 - 1 5305 - 04 5305  11 6497 6449 - 48 6370 - 79 6289 - 81 6210  12 6530 6449 - 48 6530 101 5787 102 5788  13 6819 6913 19 4 7020 107 7229 102 7238  14 6680 6530 6446 6617 144 6410 160 6575  15 6530 6446 5882 112 6517 141 6754 137 6894  16 6530 6446 5882 112 6517 141 6754 137 6894  17 5524 6652 116 6810 118 6512 118 5500  22 6576 6652 116 6810 118 6512 118 7511 7529  23 5598 5468 - 130 5340 - 128 5212 - 128 5090  24 7706 7717 111 7729 111 7529 111 7551  25 6548 6132 - 116 6619 - 113 5902 - 117 5794  26 6448 6132 - 116 6619 - 113 5902 - 117 5794  27 6589 7165 116 6619 - 113 5902 - 113 5905  28 7059 7165 116 6466 - 110 6456 111 65344 111 7551  29 6681 6570 - 110 6456 - 110 6456 111 65344 111 7551	1.80	1	4902	2000	98	5104	104		105		101
3		8	5135	5268	133	2400	132	5528	126	5655	127
4 b         5366         5292         - 74         5250         - 42         5210         - 40         5171           5 b         4661         4749         88         4839         90         4929         90         5017           6 b         44435         4543         105         4751         103         4853         507         - 40         5171         103         4853         507         - 40         5017         4853         500         22         560         5017         4853         500         22         560         22         560         22         560         22         560         22         560         22         588         101         5787         - 04         5305         - 04         5305         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302         - 04         5302 <t< td=""><td></td><td>9</td><td>4554</td><td>4555</td><td>Н</td><td>4530</td><td>- 25</td><td>4504</td><td>- 26</td><td>8444</td><td>- 26</td></t<>		9	4554	4555	Н	4530	- 25	4504	- 26	8444	- 26
6         44661         4749         88         4839         90         4929         90         5017           6         4435         4545         108         4648         105         4751         103         4653           7         5516         5568         22         5680         101         5787         102         5680           10         5048         5150         102         5685         101         5787         102         5680           11         6497         6449         -48         6770         -79         5398         -99         5348         590         5447           12         6480         702         102         5885         101         5787         102         5888         5620         5620         5620         5620         5620         5620         5620         5620         5620         5620         5789         5986 <td>-</td> <td>7</td> <td>5366</td> <td>5292</td> <td>72 -</td> <td>5250</td> <td>- 42</td> <td>5210</td> <td>04 -</td> <td>1715</td> <td>- 39</td>	-	7	5366	5292	72 -	5250	- 42	5210	04 -	1715	- 39
6         \$\text{44}\text{35}\$         \$\text{546}\text{3}\$         \$108         \$\text{446}\text{3}\$         \$109         \$\text{445}\text{3}\$         \$156         \$22         \$560         \$22         \$240         \$22         \$240         \$22         \$240         \$22         \$240         \$22         \$240         \$22         \$240         \$22         \$250         \$22         \$250         \$22         \$250         \$22         \$250         \$22         \$250         \$22         \$250         \$22         \$250         \$250         \$		2	1994	6424	88	4839	96	4929	8	5017	88
7         5516         5568         52         5587         19         5609         22         5620           9         5349         5310         - 39         5309         - 1         5305         - 04         5302           10         5048         5150         102         5249         99         - 04         5302           11         6497         6449         - 46         6370         - 79         6289         - 81         6210           12         7302         7192         - 110         7116         - 76         7041         - 75         5449           14         6980         7090         110         7122         102         7403           15         6530         6449         19         6571         27         6592         - 81         6210           16         6530         6449         19         6571         22         6592         102         7403           17         5920         110         7721         111         6574         137         6894           18         6446         116         6617         141         6754         137         7403           19		9	4435	4543	108	8494	105	4751	103	4853	102
82 11 6499 5310 - 39 5309 - 1 5305 - 04 5302 10 5946 5584 102 5585 101 5787 102 5888 11 6497 6449 - 48 6370 - 79 6289 - 81 6210 13 6819 6913 94 7020 107 7122 102 729 14 6980 7090 110 7197 107 7229 102 7403 15 6530 6549 19 6571 22 6592 21 6615 16 6330 6446 146 6617 141 6754 137 6894 17 5921 12 7302 7403 18 6146 6258 112 6480 110 6595 22 6576 6692 116 6810 118 6925 23 770 777 775 135 7510 135 7647 24 770 777 - 137 7056 - 141 6925 115 7041 25 6248 6528 116 6810 118 6925 115 7041 26 6429 6558 110 7329 112 7440 111 7529 27 6248 6576 6692 116 6810 118 6925 115 7041 28 6429 6558 110 6644 94 6750 111 7551 29 6648 6570 -110 6164 6109 110 6859 20 7705 7710 7727 111 7729 112 7440 111 7551 27 6588 775 110 6619 112 7440 111 7551 28 7059 7165 110 6104 6440 111 7529 112 7440 111 7551 28 7059 7165 110 6104 6104 7480 111 6104 7480		2	5516	5568	52	5587	19	5609	22	5620	11
9         5486         5584         102         5685         101         5787         102         5888           10         5048         5150         102         5249         99         5346         99         5447           12         7302         7192         -10         7116         -76         7041         -75         6970           13         6819         6912         94         7020         107         7122         102         723           14         6980         7090         110         7197         107         7122         102         7403           15         6530         6476         146         6617         141         6714         137         6496           16         6530         6476         146         6617         141         6714         137         7403           17         5921         6086         165         6250         164         6410         160         6575           18         6146         6258         112         6370         114         6410         160         6575           19         6571         114         6410         160         6774		ω	5349	5310	- 39	5309	٦ -	5305	<del>+00 -</del>	5302	- 03
*** 10 \$5048 \$150 102 \$5249 99 \$5348 99 \$5447   **** 11		0,	2486	5584	102	5685	101	5787	102	5888	101
*82   11   6497   6449   - 48   6370   - 79   6289   - 81   6210    13   6819   6913   94   7020   107   7122   102   7291    14   6980   7090   110   7197   107   7299   102   7403    15   6530   6476   146   6617   141   6754   137   6894    17   5921   6086   165   6250   164   6410   160   6575    18   6146   6258   112   6370   112   6480   110   6595    19   5846   5882   36   5922   40   5960   38   6002    20   7103   7240   137   7375   135   7510   135   7647    21   7334   7197   -137   7056   -141   6917   -139   6780    22   6576   6692   116   6810   118   6925   115   7044    23   5598   5468   -130   5340   -128   5212   -128   5990    24   7106   7217   111   7329   113   5945    25   6248   6132   -116   6614   94   6750   106   6859    26   6429   6538   109   6644   94   6750   106   6859    27   6385   6275   -110   6456   -114   6344   -112   6231    28   7059   7165   -111   6456   -114   6344   -112   6231    29   6681   6570   -111   6456   -114   6344   -112   6231    20   6485   6570   -111   6456   -114   6344   -112   6231    20   6485   6570   -111   6456   -114   6344   -112   6231    21   7304   -112   6454   -114   6454   -114   6534    22   7005   7005   7005   7005    23   7005   7005   7005    24   7005   7005   7005    25   6681   6670   7005    26   6482   6578   7005    27   6681   6570   -110    28   7005   7005   7005    29   6681   6450   -111    20   6450   -111   6450    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    21   7005   7005    22   7005   7005    23   7005   7005    24   7005   7005    25   7005   7005    26   7005   7005    27   7005   7005    28   7005   7005    29   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   7005   7005    20   700		91	2048	5150	102	5249	66	5348	66	545	66
12         7302         7192         -110         7116         -76         7041         -75         6970           13         6819         6913         94         7020         107         7122         102         7238           14         6580         7090         110         7197         107         7299         102         7403           15         6530         6549         19         6571         22         6592         21         6615           16         6330         6476         146         6617         141         6754         137         6894           17         5921         6086         165         6250         164         6410         160         6595           18         6146         6258         112         6370         112         6480         110         6595           19         5846         5822         40         5960         38         6002           20         7103         7240         137         7375         135         7510         135         7647           21         6576         6692         116         6810         118         6925         115		נו	2649	6449	847 -	6370	- 79	6289	- 81	6210	- 79
13         6819         6913         94         7020         107         7122         102         7238           14         6980         7090         110         7197         107         7299         102         7403           15         6530         6449         19         6571         22         6592         21         6615           16         6330         6476         146         6617         141         6754         137         6894           17         5921         6086         165         6250         164         6410         160         6575           18         6146         6258         112         6370         112         6480         110         6595           20         7103         7240         137         7375         135         7510         135         7647           21         734         7197         -137         7056         -141         6912         -139         6780           22         6576         6692         116         6810         112         7440         117         7551           23         6548         6132         -116         6619         -113	_	12	7302	7192	-110	7116	92 -	7041	- 75	0269	- 71
14         6980         7090         110         7197         107         7299         102         7403           15         6530         6549         19         6571         22         6592         21         6615           16         6330         6476         146         6617         141         6754         137         6894           17         5921         6086         165         6250         164         6410         160         6575           18         6146         6258         112         6370         112         6480         110         6595           19         5846         5882         36         5922         40         5960         38         6002           20         7103         7240         137         7375         135         7510         135         7647           21         7334         7197         -137         7056         -141         6917         -139         6780           22         6576         6692         116         6810         118         6925         115         7041           23         5598         5468         -130         5340         -128	-	13	6819	6913	76	7020	107	7122	102	7238	116
15         6530         6549         19         6571         22         6592         21         6615           16         6330         6476         146         6617         141         6754         137         6894           17         5921         6086         165         6250         164         6410         160         6575           18         6146         6258         112         6370         112         6480         110         6595           19         5846         5882         36         5922         40         5960         38         6002           20         7103         7240         137         7375         135         7510         135         7647           21         7334         7197         -137         7056         -141         6917         -139         6780           22         6576         6692         116         6810         118         6925         115         7041           23         5598         5468         -130         5340         -128         5212         -128         5090           24         7106         7217         111         7329         111		14	6980	2090	110	7197	107	7299	102	2403	104
16         6330         6476         146         6617         141         6754         137         6894           17         5921         6086         165         6250         164         6410         160         6575           18         6146         6258         112         6370         112         6480         110         6595           20         7103         7240         137         7375         135         7510         135         7647           21         7334         7197         -137         7056         -141         6917         -139         6780           22         6576         6692         116         6810         118         6925         115         7041           23         5598         5468         -137         7056         -141         6917         -139         6780           24         7106         7217         111         7329         112         7440         111         7551           25         6428         6132         -116         6619         -113         5902         -117         5790           26         6428         6275         -116         6619 <t< td=""><td>-</td><td>15</td><td>6530</td><td>6459</td><td>19</td><td>6571</td><td>22</td><td>6592</td><td>27</td><td>6615</td><td>23</td></t<>	-	15	6530	6459	19	6571	22	6592	27	6615	23
17         5921         6086         165         6250         164         6410         160         6575           18         6146         6258         112         6370         112         6480         110         6595           20         7103         7240         137         7375         135         7510         135         7647           21         7334         7197         -137         7056         -141         6917         -139         6780           22         6576         6692         116         6810         118         6925         115         7041           23         5598         5468         -130         5340         -128         5212         -128         5090           24         7106         7217         111         7329         112         7440         111         7551           25         6248         6132         -116         6019         -113         5902         -117         5790           26         6429         6538         109         6644         94         6750         106         6859           27         6385         6275         -110         6165 <td< td=""><td></td><td>16</td><td>6330</td><td>9249</td><td>146</td><td>6617</td><td>141</td><td>6754</td><td>137</td><td>7689</td><td>140</td></td<>		16	6330	9249	146	6617	141	6754	137	7689	140
18         6146         6258         112         6370         112         6480         110         6595           19         5846         5882         36         5922         40         5960         38         6002           20         7103         7240         137         7375         135         7510         135         7647           21         7334         7197         -137         7056         -141         6917         -139         6780           22         6576         6692         116         6810         118         6925         115         7041           23         5598         5468         -130         5340         -128         5212         -128         5090           24         7106         7217         111         7329         112         7440         111         7551           25         6248         6132         -116         6019         -113         5902         -117         5790           26         6429         6538         109         6644         94         6750         106         6859           27         6385         6275         -110         6456         -1		17	5921	9809	165	6250	164	0149	160	6575	165
19         5846         5882         36         5922         40         5960         38         6002           20         7103         7240         137         7375         135         7510         135         7647           21         7334         7197         -137         7056         -141         6917         -139         6780           22         6576         6692         116         6810         118         6925         115         7041           23         5598         5468         -130         5340         -128         5212         -128         5090           24         7106         7217         111         7329         112         7440         111         7551           25         6248         6132         -116         6019         -113         5902         -117         5790           26         6429         6538         109         6644         94         6750         106         6859           27         6385         6275         -110         6166         -109         6053         -113         5945           28         7059         7165         106         7270		18	9719	6258	112	6370	112	08479	110	6595	115
20         7103         7240         137         7375         135         7510         135         7647           21         7334         7197         -137         7056         -141         6917         -139         6780           22         6576         6692         116         6810         118         6925         115         7041           23         5598         5468         -130         5340         -128         5212         -128         5090           24         7106         7217         111         7329         112         7440         111         7551           25         6248         6132         -116         6019         -113         5902         -117         5790           26         6429         6538         109         6644         94         6750         106         6859           27         6385         6275         -110         6166         -109         6053         -113         5945           28         7059         7165         106         7270         105         7374         104         7480           29         6681         6570         -111         6456	,	19	2846	5882	36	5922	3	9969	38	6002	42
7334         7197         -137         7056         -141         6917         -139         6780           6576         6692         116         6810         118         6925         115         7041           5598         5468         -130         5340         -128         5212         -128         5090           7106         7217         111         7329         112         7440         111         7551           6248         6132         -116         6019         -113         5902         -117         5790           6429         6538         109         6644         94         6750         106         6859           6385         6275         -110         6466         -109         6053         -113         5945           7059         7165         106         7270         105         7374         104         7480           6681         6570         -111         6456         -114         6344         -112         6231	1.76	50	7103	2540	137	7375	135	7510	135	2492	137
6576         6692         116         6810         118         6925         115         7041           5598         5468         -130         5340         -128         5212         -128         5090           7106         7217         111         7329         112         7440         111         7551           6248         6132         -116         6019         -113         5902         -117         5790           6429         6538         109         6644         94         6750         106         6859           6385         6275         -110         6166         -109         6053         -113         5945           7059         7165         106         7270         105         7374         104         7480           6681         6570         -111         6456         -114         6344         -112         6231	_	27	7334	7197	-137	7056	-141	6917	-139	6780	-137
5598         5468         -130         5340         -128         5212         -128         5090           7106         7217         111         7329         112         7440         111         7551           6248         6132         -116         6019         -113         5902         -117         5790           6429         6538         109         6644         94         6750         106         6859           6385         6275         -110         6166         -109         6053         -113         5945           7059         7165         106         7270         105         7374         104         7480           6681         6570         -111         6456         -114         6344         -112         6231		22	9259	2699	116	0189	118	6925	115	7041	911
7106         7217         111         7329         112         7440         111         7551           6248         6132         -116         6019         -113         5902         -117         5790           6429         6538         109         6644         94         6750         106         6859           6385         6275         -110         6166         -109         6053         -113         5945           7059         7165         106         7270         105         7374         104         7480           6681         6570         -111         6456         -114         6344         -112         6231		23	5598	5468	-130	5340	-128	5212	-128	5090	-122
6248         6132         -116         6019         -113         5902         -117         5790           6429         6538         109         6644         94         6750         106         6859           6385         6275         -110         6166         -109         6053         -113         5945           7059         7165         106         7270         105         7374         104         7480           6681         6570         -111         6456         -114         6344         -112         6231		77	2106	7217	111	7329	112	2420	111	7551	111
6429         6538         109         6644         94         6750         106         6859           6385         6275         -110         6166         -109         6053         -113         5945           7059         7165         106         7270         105         7374         104         7480           6681         6570         -111         6456         -114         6344         -112         6231		25	6248	6132	-116	6109	-113	5902	-117	5790	-112
6385         6275         -110         6166         -109         6053         -113         5945           7059         7165         106         7270         105         7374         104         7480           6681         6570         -111         6456         -114         6344         -112         6231		56	6749	6538	109	th99	76	6750	901	6859	109
7059         7165         106         7270         105         7374         104         7480           6681         6570         -111         6456         -114         6344         -112         6231		27	6385	6275	-110	9919	-109	6053	-113	5945	-108
6681 6570   -111   6456   -114   6344   -112   6231		28	2059	7165	901	7270	105	7374	104	2480	901
		29	6681	6570	-111	9549	-114	4469	-112	6231	-113

No.   Reading   Indicator   Strain   Indicator	tour Indiana	R R II	मि मि सि ।
Indicator   Strain   Indicator   Strain   Indicator     Reading   Increment   Reading     5529   -126   5400     4505   -29   5111     5529   -126   5400     4505   -27   5400     4505   -39   5250     4505   -39   5250     5305   -39   5305     5305   -39   5594     5305   -39   5594     5305   -39   5594     5305   -39   5594     5305   -39   5594     5305   -30   5094     5306   -25   5566     6417   -19   6615     6490   -127   7390     5212   -106   6823     5306   -127   5306     5307   -127   5306     5308   -127	H <sub>O</sub>		From Original Reading 00 00 00 00 00 00 00 00 00 00 00 00 00
Reading   Increment Reading   120			Original Reading - 02 00 00 00 03 00 02 02 02 01
5211 - 99 5111 5220 - 26 5400 4505 - 27 4532 4931 - 86 4848 4931 - 96 5633 5600 20 5633 5305 - 97 5694 5305 - 97 5694 5305 - 97 5694 5305 - 97 5694 5305 - 104 7117 720 - 104 6615 6417 - 105 6586 6417 - 105 6586 6417 - 106 6615 6417 - 106 6615 6516 - 106 6615 6516 - 106 6615 6516 - 106 6615 6516 - 106 6615 7053 - 106 6615		4900 4554 4660 5370 4435 5519 5519 5050 7301	000000000000000000000000000000000000000
5529       -126       5400         4505       27       4532         5210       39       5250         4931       - 86       4848         4751       - 103       4651         5600       20       5633         5305       3       5305         5305       3       5305         5305       3       5305         5305       3       5305         5305       3       5305         5305       3       5305         5305       - 95       5694         7026       - 72       7117         7229       - 104       7194         6490       - 25       6566         6490       - 105       6586         6490       - 105       6382         6916       - 127       7390         5212       122       5340		5135 4554 4555 4435 5050 5050 6201 6301 6301	
4505 5210 4931 4931 4848 4848 4848 4851 5305		4554 4660 5370 4435 5789 5789 6501 6501	
5210 4931 4751 5600 5305 5306 5305		5370 4435 5519 5788 5050 6501 6301	
4931 - 86 4848 4751 -103 5600 20 5305 3 5305 3 5305 3 5305 3 5305 3 5305 3 5305 3 5305 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5694 - 97 5696 - 104 5696 - 106 6615 6615 6615 6754 - 106 6615 6754 - 127 7390 6935 - 127 7390 6935 - 126 6823 - 126 6823		4435 4435 5349 5488 6501 6501 6301	
4751 -103 4651 5600 3 5633 5305 3 5305 5305 3 5305 5305 - 97 5694 5352 - 95 5256 5282 72 6364 7127 -101 7194 6590 - 25 6566 6490 - 25 6566 6490 - 127 7390 5212 136 6823 5340		4435 5519 5349 5050 6501 6301	1 000000000000000000000000000000000000
5500 5305		5519 5349 5488 5050 6501 6301	000000000000000000000000000000000000000
5305 5352 5352 5256 5282 72 5282 72 72 72 72 72 72 72 72 72 7		5349 5488 5050 6501 7301 6820	000 000
5791 - 97 5694 5352 - 95 5256 6282 72 6364 7046 76 7117 7127 -101 7021 7299 - 25 6515 6417 -140 6615 6417 -140 6615 6417 -140 6615 6410 -126 6382 5969 - 33 5933 7520 -127 7390 6916 136 6823 6935 -106 6823 5212 122 5340		5488 5050 6501 7301 6820	00 00 00 01 01
5352 - 95 5256 6282 72 6364 7046 76 7117 7127 -101 7021 7299 - 25 6566 6754 -140 6615 6417 -158 6256 6490 -105 6382 5969 - 33 5933 7520 -127 7390 6916 136 6823 6935 -106 6823		5050 6501 7301 6820	00 04 00 01 00 00
6282 72 6364 7046 76 7117 7127 -101 7021 7299 -104 7194 6590 - 25 6566 6754 -140 6615 6417 -158 6256 6490 -105 6382 7520 -127 7390 6916 136 6823 5212 122 5340		6501 7301 6820	001
7046 76 7117 7127 -101 7021 7299 -104 7194 6590 - 25 6566 6754 -140 6615 6417 -158 6256 6490 -105 6382 5969 - 33 5933 7520 -127 7390 6916 136 6823 6935 -106 6823		7301	100
7.27		6820	10
7299 -104 7194 6566 6754 - 25 6566 615 6417 158 6256 6256 6490 105 6382 6382 6369 6369 6369 635 6916 136 6823 6516 6823 6516 6823 6516 6823 6516 6823 6516			
6590 - 25 6566 6754 - 140 6615 6417 - 158 6256 6490 - 33 5933 7520 - 127 7390 6916 136 6823 6935 - 106 6823		6980	00
6754 -140 6615 6417 -158 6256 6490 -105 6382 5969 -33 5933 7520 -127 7390 6916 136 7053 6935 -106 6823 5212 122 5340	6545 - 21	6529	- 01
6417 -158 6256 6490 -105 6382 5969 - 33 5933 7520 -127 7390 6916 136 7053 6935 -106 6823 5212 122 5340	6478 -137	6331	01
6490 -105 6382 5969 - 33 5933 7520 -127 7390 6916 136 7053 6935 -106 6823 5212 122 5340		5922	01
5969 - 33 5933 7520 -127 7390 6916 136 7053 6935 ~106 6823 5212 122 5340	6270 -112	6149	03
7520 -127 7390 6916 136 7053 6935 -106 6823 5212 122 5340	5899 - 34	5848	020
6916 136 7053 6935 ~106 6823 5212 122 5340	7	7103	00
6935 ~106 6823 5212 122 5340		2340	90
5212 122 5340		6576	00
	5469 129	5601	03
7451 -100	7236 -111	7105	- 01
5902 112		6253	05
6762 - 97 6662		6430	10
0919 901	6276 116	6391	90
7388 - 92 7289 -	_	2060	01
29 6341 110 6453 112	6570 117	8899	02

Gage		-	11000	00	22000	0	33000	20	44000	2
Factor	රිපළිම	Indicator	tor	Strain	Indicator	Strain	Indicator	Strain	Indicator	Strain
00 -	No.	Reading	60	Increment x106	Reading	Increment x106	Reading	Increment x106	Reading	Increment x106
7.00	-	4892	6664	107	5102	103	5210	108	5315	105
_	N	5125	5273	148	5412	139	5550	138	5683	133
	m	4540	4548	90	4510	- 38	14420	27 -	Other	- 30
	4	5350	5265	- 85	5221	主	5180	- 41	5128	- 52
	2	4651	4243	82	4833	8	t26th	91	5013	88
	9	14426	4545	119	4655	110	1921	109	4872	108
	2	5506	5575	69	5592	17	5608	16	5632	え
	ထ	5330	5293	- 37	5300	20	5304	70	5300	ゎ
	0	5479	5585	106	5690	11.5	5795	105	2900	105
	10	2040	5133	113	5256	103	5360	103	5470	110
1.82	11	64485	6430	- 55	6330	-100	6234	96 -	6127	-107
	12	7286	7163	-123	2080	- 83	2000	- 80	6920	- 80
	13	6815	6935	120	2902	127	7190	128	7313	123
	14	6973	7112	139	7236	124	7365	129	7485	120
	15	6518	6548	30	6575	27	9099	31	6637	31
	16	6324	6505	181	9299	171	9489	169	7011	165
	17	5913	6112	199	6303	191	9649	193	6687	191
	18	6139	6264	125	6384	120	6505	121	6625	120
	19	5833	5869	36	2900	33	5930	3	5961	31
1.76	20	6602	7218	119	7333	115	2450	117	7563	113
_	21	7387	7270	-117	7150	-120	7033	-120	6913	-120
	22	9699	6725	100	6817	92	6069	92	2000	16
<b>&gt;</b> -	23	5995	5563	-102	2460	-103	5360	-100	5261	- 99
	お	7160	2248	88	7330	82	7411	81	2495	78
	25	6300	6210	06 -	6124	- 86	6037	- 87	5950	- 87
	56	8449	6530	82	0199	8	6685	75	6762	22
	27	6402	6320	- 82	6240	- 80	6155	- 85	6072	- 83
	28	2070	7155	85	7232	27	7306	42	7382	92
	29	0029	6617	- 83	6533	78	6450	- 83	6367	- 83

			Т													_												_			
200	From	Original Reading	8	02	60	60	03	40	40	08	10	05	00	20	11	- 03	20	<del>+00 -</del>	- 01	10	05	10	90	00	19	00	(	70	90	03	05
0	Indicator	Reading	7895	5127	6454	5359	14654	4430	5510	5338	2480	5045	6485	7293	4089	0269	6525	6320	5912	0719	5838	2100	7392	6630	5684	7160		6450	80479	2073	6705
00	Strain	Increment x106	-107	-137	36	45	06 -	-114	- 17	2	-105	-104	101	85	-124	-121	- 21	-166	-188	-119	- 26	-113	120	- 91	105	- 80		62	82	- 75	87
11000	Indicator	Reading	5003	5274	4552	5264	4750	4545	5578	5291	5590	5159	6420	7165	6928	7105	6550	6500	6115	6270	5876	7229	7270	6736	5575	7260	1	6541	6320	7168	6619
00	Strain	Increment x106	-100	-139	2	39	- 87	-107	- 11	- 10	-105	-102	108	80	-127	-130	- 33	-124	-191	-119	- 31	-110	120	- 85	901	- 80		7)	178	- 70	82
22000	Indicator	Reading	5110	5411	4516	5219	0484	4659	5595	5293	5695	5263	6321	7080	7052	7226	1759	9999	6303	6389	5902	7342	7150	6827	5470	2340		0299	6238	7243	6532
	Strain	Increment x106	-105	-133	38	52	- 86	-106	- 26	- 3	-100	-105	102	80	-134	-129	- 33	-171	-191	-117	- 28	-111	117	- 87	103	- 75	(	99 -	85	69 -	83
33000	Indicator	Reading	5210	5550	0244	5180	4927	9924	9095	5303	5800	5365	6229	2000	7179	7356	7099	04789	96119	6508	5933	7452	7030	6913	5364	7420		7,699	6154	7313	6450
	Gage	No.	7	~	6	14	'n	9	2	ω	0	10	11	12	13	77	15	16	17	18	19	20	27	8	23	お	52	3	27	88	29
Load	Gage	Factor	1,80	_		>							1,82			<b>→</b>						1.76			-						

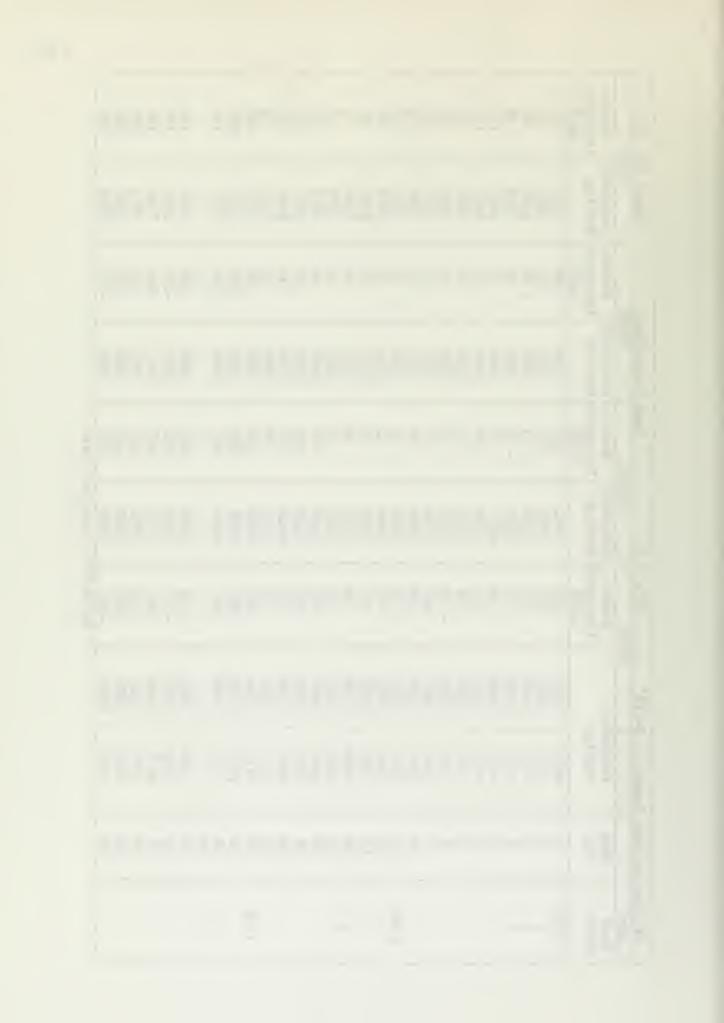
Stiffening	Ring	Breadth = 2	23 II	Pure Ben	Bending	Load	Increasing		March 23,	, 1950
Load		0	11000		22000	0	33000	0	70044	00
Gage	Саве	Indicator	or	Strain	Indicator	Strain	Indicator	Strain	Indicator	Strain
Factor	No.	Reading	ħ0	Increment x106	Reading	Increment	Reading	Increment x106	Reading	Increment
1.80	1	4882	8964	98	5058	96	5150	92	5235	85
	2	5122	5220	98	5310	8	5403	93	54495	92
	~	4530	4548	18	4564	16	4587	23	4617	200
<b>-</b>	4	5345	5324	- 21	5310	- 14	5292	- 18	5260	- 32
	5	1545	4731	85	4818	87	4907	89	0664	83
	9	4423	4504	81	4583	29	4663	80	04240	22
	2	26492		13	5518	90	5532	14	5555	23
	ω	5324	5295	- 29	5274	- 21	5250	- 24	5210	24 -
	0	5473	5550	22	5628	78	5708	80	5780	72
	10	5035	5105	20	5177	72	5250	23	5322	72
1,82	11	6475	2649	22	6506	0	6518	12	6537	19
	12	7287	7243	主一	7215	- 28	7180	- 35	7133	- 47
	13	6293	6775	- 18	6770	- 05	0929	- 10	6743	- 17
>	14	6969	6985	02	2000	15	7010	10	7025	15
	15	6520	6522	02	6525	03	6527	02	6524	- 03
	16	6310	6314	†0	6315	10	6317	020	6318	10
	17	5902	5935	33	5968	33	0009	32	6030	30
	18	6130	6203	73	6280	77	6353	23	9249	23
	19	5833	5909	92	5985	92	0909	25	6134	47
1.76	20	7103	7338	235	7570	232	7801	231	8029	228
	21	7232	6995	-237	2929	-228	6533	-234	6302	-231
	22	82479	6712	234	6945	233	7173	228	7401	228
>	23	54495	5255	-240	5030	-225	4798	-232	4566	-242
	42	6993	7238	245	7483	245	7726	243	7965	239
	25		,							
	92	6303	6459	246	0629	241	7026	236	7263	237
	27	9779	0009	-240	5763	-239	5523	-240	5285	-238
	82	6269	7170	241	2410	240	2645	235	7881	236
	29	6540	6294	-246	6055	-239	5811	1472-	5570	-241
				Table VI	. Original	Data				



				7	-									_		_					_						-					-	MC-MX.
23, 1950	0	From	Original	Heading.	8	10	40	05	03	03	0,0	90	01	05	6	03	90	02	08	60	20	63	40	- 03	60	10 -	3	- 03		- 01	12	- 01	10
March 2		Indicator	Reading	000	7887	5123	4534	5350	6494	4426	5500	5330	5474	5040	4849	7290	6629	6972	6528	6319	5909	6133	5837	2100	7243	4249	5541	1669		6302	6252	6928	6550
Ext	00	Strain	Increment	200	66 -	- 97	- 20	16	- 95	- 89	6 1	22	- 86	- 78	0	32	N	- 10	m	-1	- 36	- 17	- 82	-245	240	-245	6472	-248		-255	243	-248	249
Decreasing	11000	Indicator	Reading	1.001	47.64	5228	4550	5329	0424	4510	5510	5299	5560	5114	6500	7243	6780	0669	6525	6318	5943	6214	5920	7349	2000	6722	5289	7252		6560	6003	7184	6539
Load	00	Strain	Increment	27	1.0 -	- 92	- 20	21	- 85	- 75	- 12	562	72 -	02 -	- 14	47	14	- 13	0	0	- 29	- 29	- 73	-229	232	-226	吉	-240		-235	241	-248	247
	22000	Indicator	Reading	2007	50.63	5325	4570	5313	4835	4599	5519	5277	5646	5192	6500	7211	6775	2000	6522	6319	5979	6388	2009	7591	0929	2969	5040	7510		6815	5260	7432	6050
e Bending		Strain	Increment	OTV	2	- 78	- 27	32	- 20	99 -	た -	38	09 -	09 -	- 23	37	18	- 12	- 2	Н	- 22	- 56	- 59	-209	526	-208	230	-215		-213	234	-211	233
Breadth = 23" Pure	33000	Indicator	Reading	0762	2160	5417	4590	5292	14920	4294	5531	5248	5720	5262	6514	7170	6761	7013	6522	6319	8009	6370	6075	7820	6528	7193	9624	7750		7050	5519	7670	5803
Ring		Gage	No.		·	21	m	4	у.	9	2	∞	0,	01	H	12	13	14	1,5	16	17	18	19	8	21	22	23	ま	52	8	22	83	29
Stiffening	Load	Gage	Factor	00 -	DO: 1		- 6								1.82		-						,	1.76			•						

Table VI. Original Data

18000   27000   37744   18000   37744   18000   37744   18000   37744   18000   37744   18000   37744   18000   37744   18000   37744   18000   37744   18000   37744   18000   37744   18000   37744   18000   37744   3774   3774   3775   3	Stillening	THE DITTE									
No.   Readding   Indicator   Strain   Indicator   Strain   Indicator   Indic	Load					1800	0	2700	00	3774	9
No.   Reading   Increment   Increment   Reading   Increment   Incr	Gage	Gage	Indicat	tor	Strain	Indicator	Strain	Indicator	Strain	Indicator	Strain
*80 1 4865 4970 105 5082 112 5190 108 5320 2 5322 5290 178 5373 -123 5500 -127 5500 44 5353 5295 -58 5270 -25 5222 -28 5210 6 44458 4550 102 4654 104 4770 106 4893 6 5521 5520 -2 5 5270 -2 5 5220 -1 5 5200 8 5352 5220 -2 5 5270 -2 5 5220 -1 5 5200 8 5352 -2 560 102 4654 104 4770 106 4893 10 5090 5190 100 5286 96 5385 12 5605 11 6536 6503 -3 5738 -5 7 739 -6 1 7070 12 7740 7252 -8 700 74 700 70 700 70	Factor	No.	Reading	80	Increment x106	Reading	Increment x106	Reading	Increment x106	Reading	Increment x106
2	1.80	1	5984	02647	105	5082	112	5190	108	5320	130
1	_	8	5122	5250	128	5373	123	5500	127	5650	150
# # 5353 5295 - 58 5270 - 25 5242 - 28 5210  5 44566 4754 94 4851 97 4950 99 5065  6 44458 4566 102 44554 104 4770 106 4893  8 5382 5350 - 32 5348 - 02 5345 - 03 5346  10 5090 5190 100 5286 96 5385 - 03 5340  11 6536 6503 - 33 6446 - 57 6388 - 58 5300  12 7740 7252 - 88 7200 - 52 7385 - 58 5300  13 6887 6558 10 6870 - 52 6386 - 56 77 7790  14 7060 7140 80 7218 78 7295 - 61 7070  15 6887 6598 10 6870 - 52 6388 - 56 6380  16 6390 6497 107 6598 101 6590 600 6150  17 5925 6000 115 6410 110 6520 110 6520  18 6185 6300 115 6410 110 6520 110 6520  22 6575 6742 167 6904 165 7602 165 6500  24 7110 7275 165 6904 165 7603 161 779 7790  25 6239 6077 -162 5920 -157 5763 110 7700  26 6430 6595 115 6904 115 6910 115 7070 165 7205  27 6230 6440 165 7700 157 7700 157 7700  28 6630 6595 115 6904 1167 7700 1167 7700  29 6630 6520 115 6575 1177 7700  20 6773 6215 - 158 6062 1157 6510 1161 7700  20 6773 6215 - 158 6062 1157 7700 158 7700  20 6773 6215 - 158 6062 1157 7700 158 7700  20 6773 6215 - 158 6062 1157 7700 158 7700  20 6773 6215 - 158 6062 1157 7700 158 7700  20 6773 6215 - 158 6062 1157 7700 158 7700  20 6773 6215 - 158 6062 1157 7700 158 7700  20 6773 6215 - 158 6062 1157 7700 158 7700 158 7700  20 6773 6215 - 158 6062 1157 7700 158 7700 158 7700  20 6773 6215 - 158 6062 1157 7700 158 7700 158 7700  20 6773 6215 - 158 6062 1157 7700 158 7700 158 7700  20 6773 6215 - 158 6062 1157 7700 158 7700 158 7700  20 6773 6215 - 158 6062 1157 7700 158 7700 158 7700  20 6773 6215 - 158 6062 1157 7700 158 7700 158 7700		3	4536	4543	02	4530	- 13	4520	- 10	4500	- 20
5   \( \frac{h\cdot 6}{4458} \) \( \frac{h\cdot 6}{4458} \) \( \frac{h\cdot 6}{4458} \) \( \frac{h\cdot 6}{4564} \) \( \frac{h\cdot 6}{470} \) \( \frac{h\cdot 6}{4770} \) \( \frac{h\cdot 6}{4770} \) \( \frac{h\cdot 6}{4770} \) \( \frac{h\cdot 6}{4993}		7	5353	5295	- 58	5270	- 25	5242	- 28	5210	- 32
6 4458 4456 102 4664 104 4770 106 4893  8 5382 5560 102 5698 103 5585 12 5600  9 5502 5603 101 5708 105 5810 102 5936  10 5090 5190 100 5286 96 5386 96 5386  11 6556 6503 -33 6446 -57 6388 -58 6320  12 7340 7252 -88 7200 -52 7139 -61 7070  13 6887 6598 10 6870 -52 7139 -61 7070  14 7060 7149 80 7218 78 7295 77 7390  16 6390 6497 107 6598 101 6697 99 6817  17 5925 6060 115 6410 110 6520 110 6650  18 6185 6300 115 6410 110 6520 110 6650  19 5902 5902 586 -173 6189 129 6318 178 7855  20 7110 7251 181 7470 1779 7648 178 7855  21 733 7159 -174 6986 -173 6810 -176 6610  22 6239 6077 -162 5920 -157 5763 -157 5583  23 705 6430 6595 165 6752 157 5900 -157 5785  24 7110 7275 165 6762 -157 5900 -157 5783  25 6239 6077 -162 5920 -157 5763 -157 5583  26 6430 6595 165 6752 157 6913 151 779  27 6573 725 165 6752 157 6910 158 7730  28 7062 7225 165 6752 157 5900 -157 5785  29 6673 6510 -157 5583 -157 6012	•	5	14660	4224	ま	4851	97	4950	66	5065	115
7         5521         5560         39         5573         13         5585         12         5600           9         5382         5350         -32         5348         -02         5345         -03         5340           10         5090         5190         101         5286         96         538         99         5340           11         6536         6503         - 33         6446         - 57         6388         - 63         5340           12         7340         7252         - 88         7200         - 57         6388         - 61         7070           13         6887         6558         71         7032         74         7105         74         7195           14         7060         7140         80         720         - 52         77         7390         6320         - 61         77         7390         6300         107         640         658         77         77         7390         6470         107         658         101         6697         77         7390         6470         107         658         101         6697         79         6470         110         6598         110		.9	4458	4560	102	179917	104	4770	106	4893	123
82 5532 5563 101 5708 105 5810 102 5345 - 03 5340    10 5590 5590 101 5708 105 5810 102 5932    11 6536 6593 - 33 6446 - 57 6388 - 58 6520    12 7340 7252 - 88 7200 - 52 7139 - 61 7070    13 6887 6958 71 7032 74 710 7252    14 7060 7140 80 7218 78 7295 77 7390    15 6840 6850 10 6870 20 6882 12 6900    16 6390 6497 107 6598 101 6697 99 6817    18 6185 6300 115 6410 110 6520 110 6650    19 5502 5960 58 6020 60 6080 60 6150    22 6575 6742 167 6904 162 7070 166 7265    23 710 7275 167 6904 162 7070 167 7590    24 710 7275 165 6740 165 7602 167 5583    25 6239 6077 -162 5920 -157 5905 151    26 6430 6595 165 7780 165 7780 165 7790 167    27 6575 6742 167 6904 162 7070 167 5583    28 7062 7225 165 7780 157 7790 158    29 6673 6512 -158 6062 -157 7540 158 7730    20 7710 7225 165 7780 -157 5905 -157 6012    20 7710 7225 165 6752 157 7540 158 7730    20 7710 7225 165 7780 -157 6500 1  20 7710 7725 165 7780 157 6012 158 7730    20 7710 7725 165 7780 -157 7540 158 7730    20 7710 7725 165 7780 -157 7540 158 7730    20 7710 7725 165 7780 -157 6012 167 7700 167 6012    21 7730 7725 165 7725 1725 1725 6012 107 7700 107 6012    22 6575 6575 7725 1725 1725 1725 6012 1727 6012    23 776 6775 1720 1720 1720 1720 1720 1720 1720 1720		2	5521	5560	39	5573	13	5585	12	2600	1,5
10   5502   5603   101   5708   105   5810   102   5932     10   5090   5190   100   5286   96   5385   99   5500     11   6536   6503   -33   6446   -57   6388   -58   6320     12   7340   7252   -88   7200   -52   7139   -61   7070     13   6887   6958   71   7032   74   7106   74   7195     14   7060   7140   80   7218   78   7295   77   7390     15   6840   6850   10   6870   20   6882   12   6900     16   6390   6447   107   6498   110   6657   99   6817     18   6185   6300   115   6410   110   6520   110   6650     19   5902   5960   58   6020   60   6080   60   6150     19   5902   5960   58   6020   60   6080   60   6150     10   7231   7159   -174   6986   -173   6810   -176   6610     22   6575   6742   167   6904   165   7602   162   7800     24   7110   7275   165   7440   165   7602   157   7540     25   6430   6595   165   7440   165   7560   161     26   6430   6595   165   7382   157   7540   158     27   6430   6512   -162   5920   -157   5583     28   7062   7225   165   7382   157   7540   158     29   6673   6512   -161   6357   -155   6200   -157   6012     20   7000   7000   7000   7000     20   6673   6512   -161   6357   -155   6200   -157   6012     20   7000   7000   7000   7000     20   7000   7000   7000   7000     7000   7000   7000     7000   7000   7000     7000   7000		ω	5382	5350	- 32	5348	- 02	5345	- 03	5340	- 05
*82   10   5990   5190   100   5286   96   5385   99   5500    12   7340   7252   -88   7200   -57   6388   -58   6320    13   6887   6958   71   7032   74   7106   74   7195    14   7060   7140   80   7218   729   77   7390    15   6840   6850   10   6870   20   6882   12    16   6390   6497   107   6598   101   6697   99   6817    17   5925   6060   135   6189   129   6470    18   6185   6300   115   6410   110   6697   99   6817    19   5902   5960   58   6020   60    20   7110   7291   181   7470   179   7648   178   7855    21   733   7159   -174   6986   -173   6810   -176   6610    22   6775   6742   165   7440   165   7602   165    23   715   7255   165   7440   165   7602   167    24   710   7291   181   7470   179   7648   178   7855    25   6430   6595   165   7440   165   7602   167   5583    26   6430   6595   165   6752   157   7540   158    27   6575   6215   -161   6357   -155   6200   -157   6012    28   7667   7225   165   7382   157   7540   158    29   6673   6512   -161   6357   -155   6200   -157   6012    20   7000   7225   7225   7240   158    20   7000   7225   7225   7240   7240    20   7000   7225   7225   7240   7240    21   7240   7240   7240   7240    22   7250   7250   7250    23   7250   7250   7250    24   7200   7225   7225    25   6673   6215   -165   7260    26   6673   6215   -165   7265    27   6673   6215   -165   7265    28   7000   -157   7240    29   6673   7225   -165   7225    20   7000   7225   7225    20   7000   7225   7225    20   7000   7225   7225    20   7000   7225   7225    20   7000   7225   7225    21   7225   7225    22   7225   7225   7225    23   7225   7225   7225    24   7220   7225   7225    25   7225   7225   7225    26   7225   7225   7225    27   7225   7225   7225    28   7225   7225   7225    29   7225   7225   7225    20   7225   7225   7225    20   7225   7225   7225    20   7225   7225   7225    20   7225   7225   7225    20   7225   7225   7225    21   7225   7225    22   7225   7225    23   7225   7225    24   7225   7225    25   7225   7225		6	5502	5603	101	5708	105	5810	102	5932	122
82         11         6536         6503         - 33         6446         - 57         6388         - 58         7200         - 57         739         - 51         7070           112         7340         7252         - 88         7200         - 52         7139         - 61         7070           113         6887         6958         71         7032         74         7139         - 61         7070           114         7060         7140         80         7218         78         7295         77         7390           15         6840         6850         10         6870         20         6882         12         6900           16         6390         6497         107         6497         99         6817           17         5925         6060         135         6189         129         6318         129         6470           18         6185         6300         135         6410         110         6520         110         6697         99         6470           19         5902         5960         58         6020         60         6080         60         6080         60         6080		10	5090	5190	100	5286	96	5385	66	5500	115
12         7340         7252         - 88         7200         - 52         7139         - 61         7070           13         6887         6958         71         7032         74         7106         74         7195           14         7060         7140         80         7218         78         7295         77         7390           15         6840         6850         10         6870         20         6882         12         6900           16         6390         6497         107         6870         20         6882         12         6900           16         6390         6497         107         6870         20         6882         12         6900           17         5925         6060         135         6410         110         6697         99         6817           18         6185         6300         115         6410         179         6480         179         6470           19         5902         586         177         7648         178         7646         178         7646           23         6775         6742         167         6904         162 <td< td=""><th></th><td>נז</td><td>6536</td><td>6503</td><td>- 33</td><td>8478</td><td>- 57</td><td>6388</td><td>- 58</td><td>6320</td><td>- 68</td></td<>		נז	6536	6503	- 33	8478	- 57	6388	- 58	6320	- 68
13         6887         6958         71         7032         74         7106         74         7195           14         7060         7140         80         7218         78         7295         77         7390           15         6840         6850         10         6870         20         6882         12         6900           16         6390         6497         107         6598         101         6697         99         6817           17         5925         6060         135         6189         129         6382         12         6900           18         6185         101         6697         99         6817         690         680         66         680         6817         690         680         680         6817         680         6817         6810 <t< td=""><th>_</th><td>12</td><td>2340</td><td>7252</td><td>1</td><td>7200</td><td>- 52</td><td>7139</td><td>- 61</td><td>2070</td><td>69 -</td></t<>	_	12	2340	7252	1	7200	- 52	7139	- 61	2070	69 -
14         7060         7140         80         7218         78         7295         77         7390           15         6840         6850         10         6870         20         6882         12         6900           16         6390         6497         107         6598         101         6697         99         6817           16         6390         135         6189         129         6318         129         6817           18         6185         6060         135         6189         129         6318         129         6470           19         5902         5960         58         6020         60         6080         60         6080         60         6050         6150		13	6887	6958	7.7	7032	47	2106	472	7195	89
15         6840         6850         10         6870         20         6882         12         6900           16         6390         6497         107         6598         101         6697         99         6817           17         5925         6060         135         6189         129         638         129         6470           18         6185         6300         115         6410         110         6520         110         6650           20         7110         7291         181         7470         179         7648         178         7855           21         7333         7159         -174         6986         -173         6810         -176         6610           22         6575         6742         167         6904         162         7070         166         7265           23         710         7275         167         6904         165         6763         -157         5763         -157         5583           24         7110         7275         165         6752         157         5763         -157         5583           26         6430         6595         165	- 7	14	0902	2140	80	7218	78	7295	22	7390	95
16         6390         6497         107         6598         101         6697         99         6817           17         5925         6060         135         6189         129         6318         129         6470           18         6185         6300         115         6410         110         6520         110         6650           20         7110         7291         181         7470         179         7648         178         6450           21         7333         7159         -174         6986         -173         6810         -176         6610           22         6575         6742         167         6904         162         7070         166         7265           23         7110         7275         165         7440         165         7602         166         7265           24         7110         7275         165         7440         165         7602         166         7865           25         6239         6077         -162         5920         -157         5763         -157         5765           26         6430         6215         -158         6062         -1	-	15	04/89	6850	10	6870	20	6882	12	0069	18
17         5925         6060         135         6189         129         6318         129         6470           18         6185         6300         115         6410         110         6520         110         6650           19         5902         5960         58         6020         60         6080         60         610           20         7110         7291         181         7470         179         7648         178         7855           21         7333         7159         -174         6986         -173         6810         -176         6610           22         6575         6742         167         6904         162         7070         166         7265           23         710         7275         167         6904         162         7070         166         7265           24         7110         7275         165         7440         165         7602         166         7265           25         6430         6595         165         6752         157         6913         161         7100           28         7762         7225         163         7730         157	<u></u>	16	6390	2649	107	6598	101	2699	66	6817	120
18         6185         6300         115         6410         110         6520         110         6650           19         5902         5960         58         6020         60         6080         60         6150           20         7110         7291         181         7470         179         7648         178         7855           21         7333         7159         -174         6986         -173         6810         -176         6610           22         6575         6742         167         6904         162         7070         166         7265           23         710         7275         167         6904         165         7602         166         7265           24         710         7275         165         7440         165         7602         166         7800           25         6239         6077         -162         5920         -157         5763         -157         5583           26         6430         6595         165         6752         157         6913         161         7100           27         6572         163         7322         163         732		17	5925	0909	135	6189	129	6318	129	0249	1,52
19         5902         5960         58         6020         60         6080         60         6150           20         7110         7291         181         7470         179         7648         178         7855           21         7333         7159         -174         6986         -173         6810         -176         6610           22         6575         6742         167         6904         162         7070         166         7265           23         710         7275         167         6904         165         7602         166         7265           24         710         7275         165         7440         165         7602         167         7865           25         6239         6077         -162         5920         -157         5763         -157         5583           26         6430         6595         165         6752         157         5905         -157         5725           28         7062         7225         163         7382         157         7540         158         7730           29         6673         6512         -161         6357         -155<		18	6185	6300	115	6410	110	6520	110	6650	130
20         7110         7291         181         7470         179         7648         178         7855           21         7333         7159         -174         6986         -173         6810         -176         6610           22         6575         6742         167         6904         162         7070         166         7265           23         7110         7275         165         7440         165         7602         166         7265           24         7110         7275         165         7440         165         7602         167         7800           25         6239         6077         -162         5920         -157         5763         -157         5583           26         6430         6295         165         6752         157         6913         161         7100           27         6373         6215         -158         6062         -153         5905         -157         5725           28         7062         7240         158         7730         -157         6505         -157         6505         -157         6500         -157         6500         -157         6500		19	5902	2960	58	6020	09	0809	09	6150	20
7333 7159 -174 6986 -173 6810 -176 6610 6575 6742 167 6904 162 7070 166 7265 710 7275 165 7440 165 7602 162 7800 6239 6077 -162 5920 -157 5763 -157 5583 6430 6595 165 6752 157 6913 161 7100 6373 6215 -158 6062 -153 5905 -157 5725 7062 7225 163 7382 157 6612	1.76	20	7110	7291	181	2470	179	2648	178	7855	202
6575         6742         167         6904         162         7070         166         7265           710         7275         165         7440         165         7602         162         7800           6239         6077         -162         5920         -157         5763         -157         5583           6430         6595         165         6752         157         6913         161         7100           6373         6215         -158         6062         -153         5905         -157         5725           7062         7225         163         7382         157         7540         158         7730           6673         6512         -161         6357         -155         6200         -157         6012		21	7333	7159	-174	9869	-173	6810	-176	0199	-200
7110         7275         165         7440         165         7602         162         7800           6239         6077         -162         5920         -157         5763         -157         5583           6430         6595         165         6752         157         6913         161         7100           6430         6515         -158         6062         -157         5905         -157         5725           7062         7225         163         7382         157         7540         158         7730           6673         6512         -161         6357         -155         6200         -157         6012		22	6575	2429	167	<del>†</del> 069	162	2070	166	7265	195
6239         6077         -162         5920         -157         5763         -157         5583           6430         6595         165         6752         157         6913         161         7100           6373         6215         -158         6062         -153         5905         -157         5725           7062         7225         163         7382         157         7540         158         7730           6673         6512         -161         6357         -155         6200         -157         6012	-	23	0117	7275	165	2440	165	7602	162	2800	198
6430         6595         165         6752         157         6913         161         7100           6373         6215         -158         6062         -153         5905         -157         5725           7062         7225         163         7382         157         7540         158         7730           6673         6512         -161         6357         -155         6200         -157         6012		25	6239	6077	-162	5920	-157	5763	-157	5583	-180
6373         6215         -158         6062         -153         5905         -157         5725           7062         7225         163         7382         157         7540         158         7730           6673         6512         -161         6357         -155         6200         -157         6012		26	06490	6595	165	6752	157	6913	161	2100	187
7062         7225         163         7382         157         7540         158         7730           6673         6512         -161         6357         -155         6200         -157         6012		27	6373	6215	-158	6062	-153	5905	-157	5725	-180
6673 6512 -161 6357 -155 6200 -157 6012		83	7062	7225	163	7382	157	7540	158	7730	190
		29	6673	6512	-161	6357	-155	6200	-157	6012	-188



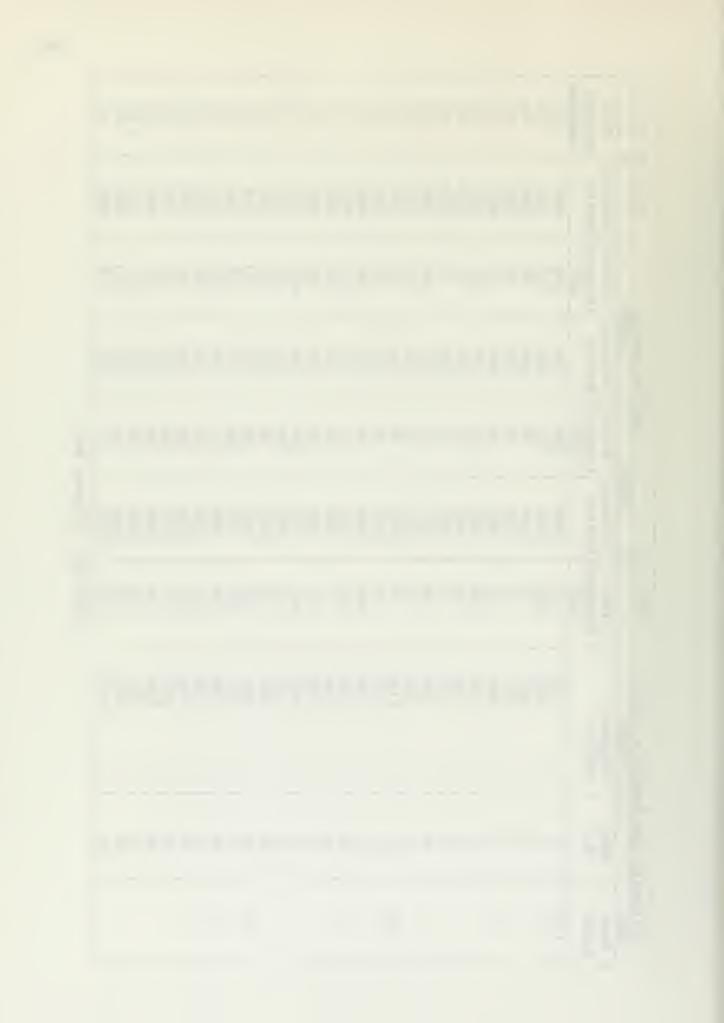
Decreasing	9100	Indicator   Strain	Reading Increment		5249 -123		5300 30	4756 - 98	4560 -104	1		7	-			6953   - 75	1	ı		·				7163 179	991- 2429	7280 -170		_	-	7230   -160	6514 164
Load De		Strain In	Increment Re	-118	-138	10	22	-106	-114	- 18	- 05	-112	-105	55	51	- 77	178 -	- 20	-103	-137	-120	99 -	-187	171	-177	-173	154	-172	153	-170	150
2	18000	Indicator	Reading	5082	5372	4525	5270	4824	1991	5562	5343	5710	5289	6435	7191	7028	7210	6855	6590	6185	6415	6209	7475	17869	6913	2450	5920	0929	6058	7390	0569
1/2		Strain	Increment x106	-120	-140	15	38	-105	-115	- 20	80	-110	-106	09	202	06 -	96 -	- 25	-124	-148	-115	- 55	-193	203	-175	-177	183	-168	180	-170	188
Breadth = $2-1/8$ "	27000	Indicator	Reading	5200	5510	4515	5248	0964	4778	5580	5348	5822	5394	6380	2140	7105	7294	6875	6699	6322	6535	9609	7662	6813	2090	2623	5766	6932	5905	7560	6200
Ring		Gage	No.	Н	2	<u>س</u>	4	7	9	2	ω	0,	10	11	12	13	14	15	16	17	18	19	20	21	22	೪ನ	25	56	27	28	62
Stiffening	Load	Gage	Factor	1.80	1			->						1.82	_			-	-				1.76			-					

Table VII. Original Data

Stiffening Ring	1 1	Breadth =	2-1/8"	= 0/2	.35	Load	Increasing	***	March 29	, 1950
Load		0	סנ	0000	, 20000	0	30000	00	00004	00
Gage	Gage	Indicator	tor	Strain	Indicator	Strain	Indicator	Strain	Indicator	Strain
Factor	No.	Reading	<b>b</b> D	Increment	Reading	Increment x106	Reading	Increment x106	Reading	Increment x106
1.80	٦	9984	0264	104	5078	1.08	5181	103		105
	2	5124	5260	136	5392	132	5525	133	5655	130
	m	4540	4560	20	4537	- 23	4512	- 25	6844	- 23
	4	5352	5267	- 85	5227	047 -	5189	- 38	5148	- 41
>	N	0994	4750	06	4843	93	4937	76	5027	90
	9	0944	4570	110	4677	107	484	107	06847	106
	2	5530	2600	20	5620	20	5637	17	5655	18
	ω	5377	5330	24 -	5328	- 02	5325	- 03	5321	<del>10</del> -
	6	5510	5608	86	5712	104	5816	104	5920	104
	10	5090	5200	110	5300	100	5402	102	5503	101
1,82	11	6548	6513	- 35	6430	- 83	6355	- 75	6229	- 76
	12	2340	7217	-123	7144	- 73	2902	- 77	6992	- 75
	13	6887	6985	86	2090	105	7194	104	7300	106
>	14	2090	7172	82	7280	108	7385	105	0647	105
	15	6830	6850	8	6871	21	6893	25	6915	22
	16	6398	6547	149	2899	140	6827	140	9969	139
	17	5930	0019	170	6264	164	6249	165	6591	162
	18	9619	6311	115	6428	117	6541	113	9599	115
	19	5910	5950	\$	9665	04	6032	77	6073	41
1.76	20	7114	7253	139	7394	141	7532	138	7670	138
	21	7343	7205	-138	2065	-140	6925	-140	6785	-140
	22	6578	0029	122	6820	120	6639	119	7058	119
<u></u>	23	5570	2440	-130	5312	-128	5185	-127	5060	-125
	77	7112	7228	116	7342	114	7457	115	7570	113
	25	84729	6130	-118	9109	-114	2900	-116	5788	-112
	56	6432	6545	113	6655	110	4929	109	6872	108
	2,1	4859	6274	-110	6160	-114	6050	-110	2940	-110
	88	4902	7178	114	7286	108	7393	107	7500	107
	29	6683	6570	-113	6458	-112	9469	-112	6233	-113
				Table VII	I. Original	1 Data				



or         Strain         Indicator         Strain         Indicator         Strain           5189         - 97         5089         -100         4980         -109           5527         - 128         5404         -123         5267         -137           4512         23         4540         28         4568         -109           5527         - 128         5404         -123         5267         -137           44512         23         4540         28         4568         -109           5527         - 18         4457         - 137         4688         - 137           4478         - 18         4456         - 137         4688         - 109           4788         - 10         5234         - 45         4568         - 11           4788         - 10         5539         - 10         4577         - 11           5636         - 19         5529         - 10         4577         - 11           5636         - 10         5727         - 9         5618         - 10           5782         - 6         6868         - 10         6740         - 12           5890         - 10         6740<	Stiffening	Ring	Breadth = 2-1/8"		35	Load	Decrea	8.0	March 29	, 1950
Gage	Load		30000		2000	00	1000	00	0	
No.   Reading   Increment   Reading   Increment   Reading   Increment   2189   -97   -128   5267   -129   5267   -129   5267   -137   -137	Gage	Gage	Indicator	Strain	Indicator	Strain	Indicator	Strain	Indicator	From
.80 1 5189 -97 5089 -100 4980 -109 5287 -128 5494 -123 5267 -137 4540	Factor	No.	Reading	Increment		Increment x106		Increment x106	Reading	Original Reading
2	^	r-1	5189	- 97	5089	-100	4980	-109	179817	- 02
1		2	5527	-128	5404	-123	5267	-137	5122	- 02
4    4    4942		m	4512	23	4540	28	4568	28	4544	70
5		7	5189	41	5234	45	5274	24	5356	70
6 4788 -102 4688 -100 4577 -111  8 5536 -19 5619 -17 5600 -19  9 5822 -98 5727 -95 5618 -109  10 5410 -93 5733 -97 5209 -104  11 6530 -10 571 6434 84 6516 82  12 7700 77 78 7742 -95 5618 -109  13 7718 -102 7092 -106 6518 -109  14 7382 -108 7280 -26 6840 -28  15 6825 -141 6687 -126 6510 -170  16 6825 -141 6687 -136 6510 -170  17 6820 -161 6270 -160 6510 -170  18 6820 -127 7413 -130 7260 -123  19 6925 -140 6840 -130 6707 -133  22 6926 -108 6840 -106 6707 -133  23 5186 -126 5714 -106 6707 -127  24 7470 -100 7364 -106 6707 -127  25 5186 -12 5186 -100 6555 -123  26 6778 -94 6678 -100 6555 -123  27 6050 -10 6162 -10 6570 -10 6707  28 7407 -93 7364 -106 6570 -120  29 7407 -93 7364 -106 6570 -120  20 6345 -11 70 6510 -100 6555 -123  20 7407 -91 70462 -11 70462 -11 704621 -11 704	>	7	2464	- 85	4857	- 85	09247		0994	8
.82 11 5636 - 19 5619 - 17 5600 - 19 533 04 533 03 04 533 03 04 533 03 04 533 03 04 533 03 04 533 03 04 533 03 04 533 03 04 532		9	14788	-102	14688	-100	4577	-111	4457	- 03
8 5326 05 5330 04 5333 03 00 5410 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		2	5636	- 19	5619	- 17	5600	- 19	5530	00
10   5822		ω	5326	05	5330	70	5333	03	5378	01
.82   10   5410   - 93   5313   - 97   5209   -104   12   7070   71   6434   84   6516   82   13   7198   -102   7092   -106   66983   -109   14   7382   -108   7280   -102   6840   -122   15   6825   -141   6687   -138   6540   -147   17   6430   -161   6270   -160   6940   -170   18   6040   -23   6008   -32   5953   -155   19   6040   -23   6008   -32   5953   -155   22   6950   -108   6840   -110   6707   -137   24   7470   -100   7364   -106   6727   -127   25   5900   112   6678   -100   6555   -123   26   6678   -94   6678   -100   6555   -123   27   6050   110   6162   112   6570   -110   28   7407   -93   7308   -99   7185   -123   29   6345   112   6460   115   6570   110   29   7845   112   6460   115   6570   110   20   7407   -93   7308   -99   7185   -123   20   7407   -93   7308   -99   7185   -123   21   7401   7460   711   7185   6570   110   22   7407   -93   7308   -99   7185   -123   24   7407   -93   7308   -99   7185   -123   25   6345   112   6460   115   6570   110   26   6345   112   6460   115   6570   110   27   7407   -93   7308   -99   7308   -99   28   7407   -93   7308   -99   7308   -123   29   7407   7407   7407   7407   7407   7407   7407   20   7407   7		0	5822	- 98	5727	- 95	5618	-109	5508	- 02
.82   11   6350		10	5410	- 93	5313	- 97	5209	-104	5090	8
12	٥	11	6350	71	6434	48	6516	82	6547	- 01
13 7198 -102 7092 -106 6983 -109 14 7382 -108 7280 -102 7170 15 6890 - 25 6868 - 22 6840 - 28 16 6825 -141 6687 -138 6540 -147 17 6430 -161 6687 -160 6100 -170 18 6550 -106 6442 -108 6316 -125 20 7543 -127 7413 -130 7260 -153 21 6925 140 7065 140 7203 138 22 6950 -108 6840 -110 6723 -123 24 7470 -100 7364 -106 6130 114 25 5900 112 6678 -100 6555 -123 27 6650 110 6162 112 6272 110 28 7407 - 93 7308 - 99 7185 -123 29 . 6345 112 6460 115 6570 110		12	7070	78	7142	72	7217	75	7338	- 02
14 7382 -108 7280 -102 7170 -110 6890 -25 6840 -28 6840 -28 6840 -147 6687 -138 6540 -147 6687 -138 6540 -147 6687 -138 6540 -147 6687 -150 6100 -170 6430 -161 6270 -160 6100 -170 6550 -106 6442 -108 6316 -126 6100 -170 7543 -127 7413 -130 7260 -153 138 722 6950 -108 6840 -110 6707 -133 5186 126 5314 128 5440 126 7237 -127 7470 -100 7364 -106 7237 -127 7470 -100 7364 -106 6555 -123 5186 126 6778 -94 6678 -100 6555 -123 5180 22 6550 110 6162 112 6272 110 6777 -93 7308 -99 7185 -123 5180 110 6162 112 6570 110		13	7198	-102	7092	-106	6869	-109	6881	90 -
15 6890 - 25 6868 - 22 6840 - 28  16 6825 -141 6687 -138 6540 -147  17 6430 -161 6270 -160 6100 -170  18 6550 -106 6442 -108 6316 -126  19 6040 - 33 6008 - 32 5953 - 55  20 7543 -127 7413 -130 7260 -153  22 6925 140 7065 140 7265 -133  23 6950 -108 6840 -10 6707 -133  24 7470 -100 7364 -106 7237 -127  25 5900 112 6616 116 6130 114  26 6778 - 94 6678 -100 6555 -123  27 6050 110 6162 112 6572 -110  28 7407 - 93 7308 - 99 7185 -123  29 6345 112 64460 115 6570 110		14	7382	-108	7280	-102	7170	-110	7052	- 38
16 6825 -141 6687 -138 6540 -147   17 6430 -161 6270 -160 6100 -170   18 6550 -106 6442 -108 6316 -126   19 6040 - 33 6008 - 32 5953 - 55   22 6925 140 7065 140 7203 138   23 5950 -108 6840 -110 6707 -133   24 7470 -100 7364 -106 7237 -127   25 5900 112 6678 -106 6555 -123   26 6678 - 94 6678 -100 6555 -123   27 6650 110 6162 112 6272 110   28 7407 - 93 7308 - 99 7185 -123   29 6345 112 6460 115 6570 110		15	0689	- 25	8989	- 22	0489	- 28	6820	- 10
17		16	6825	14/1	2899	-138	04759	-147	6390	ಐ ೧ ၂
18		17	0649	-161	6270	-160	6100	-170	5923	- 02
19   6040		18	6550	-106	2449	-108	6316	-126	0619	90 ~
76 20 7543 -127 7413 -130 7260 -153 138 6925 140 7065 140 7203 138 138 6950 -108 6840 -110 6707 -133 5186 126 5314 128 5440 126 5707 -133 5900 112 6678 -106 6555 -127 5900 110 6162 112 6572 -110 6555 -123 528 74407 - 93 7308 - 99 7185 -123 510 5570 110 6162 112 6570 110 6162 112 6570 110	,	61.	0409	- 33	8009	. 32	5953	- 55	5903	- 02
6925 140 7065 140 7203 138 6950 -108 6840 -110 6707 -133 5186 126 5314 128 5440 126 7470 -100 7364 -106 7237 -127 5900 112 6678 -100 6555 -127 6050 110 6162 112 6272 -110 7407 - 93 7308 - 99 7185 -123 6570 110 6180 115 6570 110	0	20	7543	-127	7413	-130	7260	-153	7109	- 05
6950 -108 6840 -110 6707 -133 5186 126 5314 128 5440 126 7470 -100 7364 -106 7237 -127 5900 112 6616 116 6130 114 6778 - 94 6678 -100 6555 -123 6050 110 6162 112 6272 -110 7407 - 93 7308 - 99 7185 -123 6345 112 6460 115 6570 110		27	6925	140	7065	140	7203	138	234	01
5186 126 5314 128 5440 126 727 7470 -100 7364 -106 7237 -127 5900 112 6016 116 6130 114 6778 - 94 6678 -100 6555 -123 6050 110 6162 112 6272 110 7407 - 93 7308 - 99 7185 -123 6345 112 6460 115 6570 110		22	6950	-108	0489	-110	6707	-133	6572	90 -
7470 -100 7364 -106 7237 -127 5900 112 6016 116 6130 114 6778 - 94 6678 -100 6555 -123 6050 110 6162 112 6272 110 7407 - 93 7308 - 99 7185 -123 6345 112 6460 115 6570 110	- 30-	53	5186	126	5314	128	2440	126	5573	3
5900 112 6016 116 6130 114 6778 - 94 6678 -100 6555 -123 6050 110 6162 112 6272 -110 7407 - 93 7308 - 99 7185 -123 6345 112 6460 115 6570 110 Table VII. Original Data		お	0242	-100	7364	-106	7237	-127	2106	90 -
6778 - 94 6678 -100 6555 -123 6050 110 6162 112 6272 110 7407 - 93 7308 - 99 7185 -123 6345 112 6460 115 6570 110		25	2900	112	9109	116	6130	114	6248	00
6050 110 6162 112 6272 110 7407 - 93 7308 - 99 7185 -123 6345 112 6460 115 6570 110 Table VII. Original Data		56.	6778	- 94	8299	-100	6555	-123	6749	- 03
7407 - 93 7308 - 99 7185 -123 6345 112 6460 115 6570 110 110		22	6050	110	6162	715	6272	011	6383	- 01
6345 112 6460 115 6570 110 Table VII. Original Data		82	2072	- 93	7308	- 99	7185	-123	0902	さつ・
VII. Original		29	. 6345	. 112	09479	11.5	6570	110	4899	01



Gage		0	11(	000	22000	0	33000	00	00077	0
cor	Gage	Indicator		Strain	Indicator	Strain	Indicator	Strain	Indicator	Strain
	No.	Reading	, 50	Increment x106	Reading	Increment	Keading	Increment	Reading	Increment
80	-	4852	4963	111	5073	110	5180	107	5288	108
	2	5119	5260	141	5402	142	5542	140	5680	138
	<u></u>	4539	4553	17	452n	- 33	08474	047	3445	- 35
	4	5350	5246	~104	5202	主!	5158	村一	51.15	- 43
-	7	4657	4743	86	4838	95	4930	92	5022	92
	9	453	4568	115	7894	114	4793	111	4905	112
	2	5526	5604	78	5624	82	5645	21	5665	20
	ω	5372	5312	09 -	5320	08	5320	00	5322	02
	0	5505	5606	101	5717	111	5826	109	5933	107
	10	5086	5200	114	5307	107	5412	105	5520	108
.82	11	6543	2649	- 46	00179	- 97	6305	- 95	6217	- 88
_	12	7336	7193	-143	7110	- 83	7028	- 82	6950	- 78
	13	6885	2005	120	7136	131	7265	129	2400	135
~	14	7051	7183	132	7312	129	2470	128	7574	134
	15	6819	6835	16	6862	27	0689	28	6920	000
	16	6392	6573	181	2429	174	6919	172	7607	178
	17	5924	6120	196	6317	197	6510	193	6710	200
	18	6190	6316	126	07:19	124	6563	123	1699	128
	19	5905	5932	30	5968	36	0009	32	0409	2
.76	20	7110	7228	118	7345	117	7461	116	7585	124
	21	7342	7220	-122	7101	-119	0869	-121	6870	-110
	22	6570	4999	176	0929	96	6853	93	6953	100
-	23	5570	2466	-104	5365	-101	5261	-104	5167	76 -
	77	7104	7190	98	7275	85	7360	85	7451	91
	25	6245	6151	16 -	9909	- 85	5977	- 89	5898	- 79
	56	6428	6510	82	6590	80	8999	78	6754	86
	27	6382	6300	- 32	6218	- 82	6132	98 -	6058	72 -
	82	7055	7140	85	7220	80	7297	77	7380	83
	29	6899	0099	- 83	6516	† <sub>8</sub> -	6432	178 -	6355	- 77

1.80 1.80 1.82 1.82 1.82 1.82 1.82 1.82 1.82 1.82	Indicator Reading 5190 5190 5546 4492 5159 4938 4800 5652 5320 5832 5420 5305	Strain Increment x106 - 98 - 1 P 47 44	Indicator	Stronge	V 2 4	10		5
		Increment x106 - 98 -1 in 4/4 4/4	Reading	TTETAC	Indicator	Strain	Indicator	LLOW
8	5190 5546 4492 7159 7159 7159 7159 7159 7159 7150 7150	1 98 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	)	Increment	Reading	Increment	Reading	Original Reading
8	5546 44926 44938 4800 5320 5320 5420 5300	74 4 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	5082	~108	4975	-107	1984	12
8	4492 5159 4938 4800 5652 5320 5320 5305	74 - 84	5410	-136	5270	-140	5120	01
85	5159 4938 5852 5320 5320 5320 5300 5300	李	4520	28	4559	39	4540	07
89	4938 4800 5320 5832 5832 6305	- 84	5210	51	5256	947	5357	02
8	480 532 532 532 532 532 532 532 532 532 532		6484	- 89	4756	- 93	0994	03
8,	5652 5320 5832 5420 5420	-105	06947	-110	4578	112	14456	03
8	5320 5832 5420 6305	- 13	5625	- 27	5608	- 17	5527	01
88,	5832 5420 5420 6305	- 02	5322	02	5320	- 02	5374	02
8	5420	-101	5730	-102	5620	-110	5511	90
8,	6305	-100	5317	-103	5210	-107	5089	03
133		88	4049	66	6502	98	6552	60
133	(0)5	82	7114	82	7199	85	7340	70
77.	7271	-129	7138	-133	7010	-128	6887	02
	0440	-134	7312	-128	7185	-127	7051	00
15	9889	76 -	6855	_ 31	6827	. 28	6803	- 16
16	6920	-177	8429	-172	6576	-172	6397	05
17	6518	-192	6324	-194	6131	-193	5930	90
18	6573	-118	6453	-120	6330	-123	6200	10
19	6012	- 28	5981	- 31.	5950	- 31	5910	90
1.76 20	2473	-112	3960	-113	7241	-119	7111	UJ
12	4369	114	7102	118	7222	120	7345	03
200	9989	- 87	9229	06.	0899	96 -	6573	03
23	5266	66	5366	100	5470	104	5580	10
773	7.373	- 78	7293	- 80	7210	- 83	2110	90
25	5980	82	2909	87	6155	88	65/16	1/0
26	6682	- 72	6099	- 73	6528	- 81	6432	き
27	6136	7.8	6220	84	6,303	83	0629	85
28	73:0	22 -	7236	72 -	7158	- 78	0902	95
50	6435	98	6518	83	€099	8.5	1699	80



, 1950	0	Strain	Increment x106	93	106	٦	12	92	88	9 -	N	88	26	Н	- 10	- 2	20	10	2	37	80	83	238	-229	240	-234	250	-235	8472	-234	243	-238	
March 29,	00044	Indicator	Reading	5223	5508	4532	5357	5011	4780	5485	5340	5832	5370	6545	7249	6830	7104	0089	6381	2409	6491	6212	8050	6382	7511	4590	8091	5265	2042	2400	8022	5690	
5.0	00	Strain	Increment x106	93	98	٦ ء	10	91	82	- 15	2	83	7.1	9	0,	2	14	<u></u>	m	34	79	80	232	-232	233	-238	544	-236	243	-238	241	-241	
Increasing	33000	Indicator	Reading	5130	5405	4531	5345	4919	7695	5491	5335	5744	5291	6544	7259	6837	7084	0629	6329	0109	6411	6159	7812	1199	7271	14854	7841	5500	7154	5634	2779	5928	
Load	00	Strain	Increment x106	91	お	0	ň	88	80	- 16	<u>س</u>	81	69	6 1	- 13	- 10	10	Н	7 -	82	72	29	238	-238	237	-247	9472	-242	247	1.47-	24.7	-246	1 Data
Bending	22000	Indicator	Reading	2605	5304	4532	5335	14828	4610	5506	5333	5661	5220	6550	7268	<del>111</del> 89	2070	6787	9269	9265	6332	64709	7580	6843	7038	5062	7597	5736	6911	5872	7538	6919	[. Original
Pure Ben	000	Strain	Increment x106	89	66	10	- 11	88	82	4	- 19	62	73	17	- 38	- 16	16	m	0	33	92	75	234	-239	234	15/2-	248	-242	245	-243	244	-250	Table VII
2-1/8"	1100(	or	80	9464	5210	4540	5330	4739	4530	5522	5336	5580	5151	6559	7281	6854	2060	9829	6380	5948	6260	5970	7342	7081	6801	5309	7351	5978	0299	6119	7297	7415	
Breadth = 2	0	Indicator	Reading	14857	5111	4530	5341	4650	8777	5518	5355	5501	5078	6542	7319	6870	2044	6783	6380	5915	6184	5895	7108	7320	6567	5553	7103	6220	6425	6362	7053	6665	
Ring		Gage	No.	7	2	<u>س</u>	47	~	9	2	ω	6	10	11	12	13	14	15	16	17	18	19	8	21	22	23	77	25	56	27	82	29	
Stiffening	Load	Gage	Factor	1.80			->-							1,82			_						1.76			-							

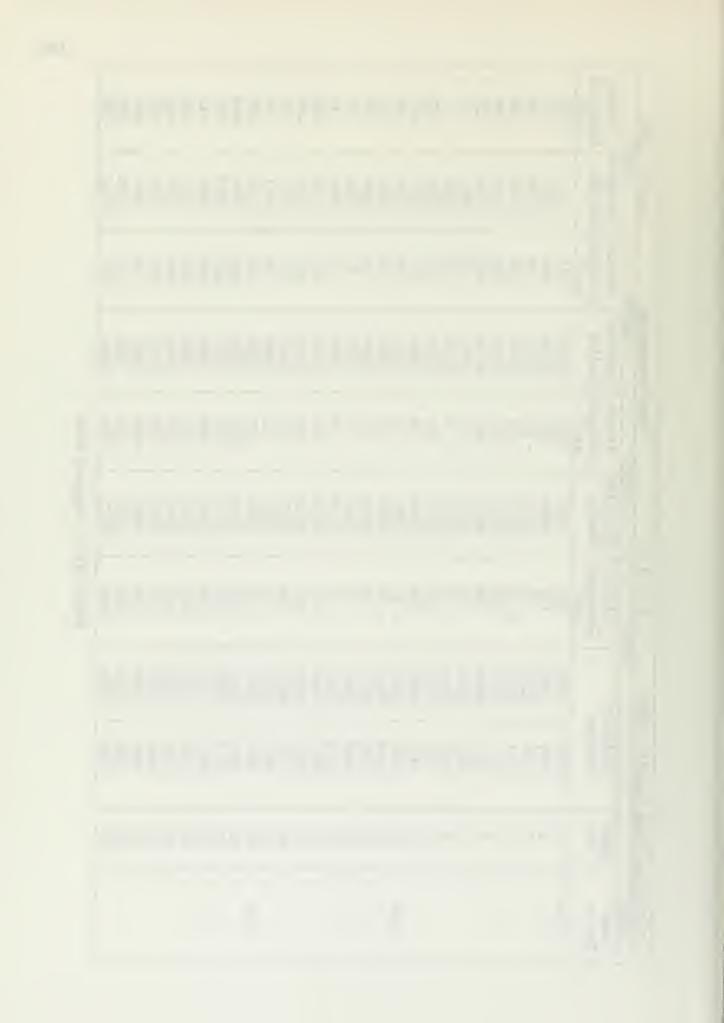
Load   13000   Load   13000   Load   Load	Stiffening	Ring	Breadth = 2-1/8"	Fure Bending		Load	Decrea		March 29	, 1950
No.   Reading   Indicator   Strein   Indicator   Strain   Indicator   Indicator   Strain   Indicator   Increment   Reading   Increment   Reading   Increment   Reading   Increment   Inc	Load		33000		2200	0	1100	0		
No.         Reading         Increment Reading	Jage	Gage	Indicator	Strain	Indicator	Strain	Indicator	Strain	Indicator	From
Second	actor	No.	Reading	Increment x106	Reading	Increment x106	Reading	Increment x106	Reading	Original Reading
2         5420         - 88         5320         -100         5220         -100         5113           4         5390         - 2         4536         - 10         5320         - 100         5113           4         5390         - 2         4536         - 10         4541         - 5         4531           5         4469         - 28         4540         - 10         4531         - 6         5340           6         4498         - 28         4540         - 83         4456         - 83         4458           7         5490         - 74         4623         - 83         4540         - 83         4458           9         5761         - 71         5680         - 81         5525         21         5360           10         5307         - 63         5237         - 70         5360         - 8         5565           11         6536         - 83         4640         - 8         5505         - 8         5505           10         6530         - 63         5237         - 70         5340         - 70         5340         - 70         5340         - 70         5540         - 14         7044	1.80	7	5145	- 78	5055		4958	- 97	09847	03
3	_	2	5420	- 88	5320	-100	5220	-100	5113	02
\$\beta\$         \$\beta\$ <t< td=""><td></td><td><u></u></td><td>4530</td><td>- 2</td><td>4536</td><td>9</td><td>4541</td><td>2</td><td>4531</td><td>01</td></t<>		<u></u>	4530	- 2	4536	9	4541	2	4531	01
5         4983         -28         4849         -134         4751         - 98         4458           6         4706         - 74         4623         - 83         4540         - 83         4450           7         5940         - 7         5680         - 81         5525         - 21         5522           10         5761         - 71         5680         - 81         5592         - 88         5505           11         6538         - 7         5680         - 81         5592         - 88         5505           12         6538         - 7         5680         - 81         5592         - 88         5505           13         6842         - 71         5680         - 81         5592         - 88         5505           13         6842         - 7         5680         - 81         5505         - 88         5505           13         6842         - 7         5680         - 81         5654         - 77         5081           14         7782         - 14         7782         - 16         6782         - 77         5081           15         6620         - 14         7782         - 76	٠,-	14	5350	- 7	5340	- 10	5336	47	5347	90
6         4706         - 74         4623         - 83         4540         - 85         4450         - 85         4450         - 83         4450         -	-	v	4983	- 28	64784	-134	4751	98	4658	08
7         5490         5         5504         14         5525         21         5522           9         5761         - 71         5680         - 81         5340         2         5360           10         5376         - 71         5680         - 81         5592         - 88         5560           11         6538         - 7         5680         - 81         5592         - 88         5505           12         6538         - 7         6540         2         5340         - 77         5081           12         6538         - 7         6540         2         6555         14         7721           13         6842         - 7         6540         - 7         6546         - 7         5081           14         7090         - 14         7074         - 16         6788         - 7         6546           15         6620         - 11         6782         - 7         6788         - 8         6789           16         6789         - 11         6782         - 7         6788         - 7         6781           16         6780         - 11         6782         - 7         6788		· •	4706	46 -	4623	- 83	4540	- 83	14450	02
8         5340         0         5338         -         2         5340         2         5360         -         8         5360         -         8         5360         -         8         5360         -         8         5360         -         8         5360         -         8         5565         -         8         5565         -         8         5565         -         8         5565         -         8         5565         -         8         5565         -         8         5565         -         8         5565         -         8         5565         -         8         5565         -         8         5565         -         8         5565         -         7         6546         -         15         6546         -         15         6546         -         15         6546         -         15         6546         -         16         6546         -         16         6546         -         16         6546         -         16         6546         -         16         6546         -         16         6546         -         16         16         6646         -         16         6646         -		2	5490	2	5504	14	5525	27	5522	70
82         10         \$761         - 71         \$680         - 81         \$592         - 88         \$505           11         \$638         - 7         \$636         - 7         \$655         14         \$705           12         \$7258         - 7         \$654         2         \$655         14         \$731           13         \$6842         12         \$685         10         \$782         14         \$731           13         \$689         - 14         \$707         - 16         \$685         11         \$6878           14         \$7090         - 14         \$707         - 16         \$6862         8         \$6878           15         \$6789         - 14         \$707         - 16         \$6862         8         \$6878           16         \$6789         - 14         \$707         - 16         \$6789         - 7         \$6789           16         \$6789         - 11         \$6782         - 7         \$6788         - 8         \$6878           16         \$6380         - 16         \$6782         - 7         \$6788         - 7         \$6789           18         \$64430         - 61         \$634		- ω	5340	0	5338	- 2	5340	~	5360	0.5
10   5307   - 63   5237   - 70   5160   - 77   5081   12   7258   - 7   6540   2   6555   15   6545		6	5761	- 71	5680	- 83	5592	- 88	5505	70
11		10	5307	- 63	5237	- 70	5160	- 77	5081	03
12	1.82	11	6538	1	6540	2	6555	15	6545	03
13         6842         12         6854         12         6862         8         6878           14         7090         - 14         7074         - 16         7066         - 8         7051           15         6789         - 11         6782         - 7         6786         - 6         6789           16         6789         - 11         6782         - 7         6786         - 6         6789           16         6789         - 11         6782         - 7         6786         - 6         6789           16         6789         - 11         6782         - 7         6786         - 8         6789           17         6020         - 27         5990         - 30         5958         - 32         5922           18         6148         - 61         634         - 76         6272         - 86         6789           20         7836         - 21         7601         - 23         736         - 245         6790           21         6607         224         7601         - 23         7061         - 243         6764           22         7869         - 22         7625         - 244         7	-	12	7258	0	7268	10	7282	77	7321	02
1¼         7090         - 14         7074         - 16         7066         - 8         7051           15         6789         - 11         6782         - 7         6788         6 6789           16         6380         - 1         6380         - 7         6788         6 6789           16         6380         - 1         6380         - 30         5958         - 32         5922           17         6020         - 27         5990         - 30         5958         - 32         5922           19         6430         - 61         6354         - 76         6272         - 82         6190           20         7836         - 214         7601         - 235         7356         - 2445         7106           21         6607         225         6840         233         7082         242         730           22         7869         - 225         7660         244         7367         242         730           24         7869         - 222         7625         - 244         7367         248         6564           25         5495         - 222         6940         - 240         6688         - 252 </td <td></td> <td>13</td> <td>6842</td> <td>12</td> <td>4589</td> <td>12</td> <td>6862</td> <td>ω</td> <td>6878</td> <td>80</td>		13	6842	12	4589	12	6862	ω	6878	80
15         6789         - 11         6782         - 7         6788         6         6789           16         6380         - 1         6380         - 7         6788         6         6789           17         6020         - 27         5990         - 30         5958         - 32         5922           18         6430         - 61         6354         - 76         6272         - 82         6190           19         6430         - 61         6354         - 76         6272         - 82         6190           20         7836         - 21         760         - 79         5983         - 86         5900           21         6607         - 214         7601         - 235         7356         - 245         7106           22         7298         - 213         7061         - 237         6818         - 243         730           23         7869         - 222         7625         - 244         7367         - 258         7105           24         7869         - 222         7625         - 244         7367         - 258         7105           25         5495         - 230         5870         - 240	-	14	2090	- 14	4202	- 16	9902	80	7051	02
16         6380         -         1         6380         -         1         6387         7         6387           17         6020         -         27         5990         -         30         5958         -         32         5922           18         6430         -         6148         -         6148         -         6272         -         82         6190           19         6148         -         649         -         76         522         6190         -         86         5900           20         7836         -         -         649         -         79         5983         -         86         5900           21         6607         224         7601         -235         7356         -245         7106         -           22         7298         -213         7061         -237         6818         -243         6564         -           23         5495         -222         7625         -244         7367         -258         6428           24         780         -222         7625         -244         736         248         6427           28		15	6869	- 11	6782	2 -	6788	9	6889	90
17         6020         - 27         5990         - 30         5958         - 32         5922           18         6430         - 64         6069         - 76         6272         - 82         6190           19         6148         - 64         6069         - 79         5983         - 86         5900           20         7836         - 214         7601         -235         7356         -245         7106           21         6607         225         6840         233         7082         244         7366           22         7298         -213         7061         -237         6818         -243         7306           23         4820         -225         7625         -244         7367         -258         7105           24         7869         -222         7625         -244         7367         -258         7105           25         5495         -222         7625         -244         7367         -258         6427           27         5630         230         5870         -240         6120         250         6571           28         7801         -221         77563         -238		16	6380	-	6380	0	6387	~	6387	0.2
18         6430         - 61         6354         - 76         6272         - 82         6190           19         6148         - 64         6069         - 79         5983         - 86         5900           20         7836         -214         7601         -235         7356         -245         7106           21         6607         225         6840         233         7082         242         7360           22         7298         -213         7061         -237         6818         -243         7360           23         4820         230         5060         240         5310         256         5561           24         7869         -222         7625         -244         7367         -258         7105           25         5495         230         5732         237         5980         248         6230           26         7180         -222         6940         -240         6688         -252         6423           27         5630         230         5870         240         6120         252         7052           28         7801         -221         7563         -238         <		17	6020	- 27	5990	- 30	5958	- 32	5922	02
19         6148         - 64         6069         - 79         5983         - 86         5900           20         7836         -214         7601         -235         7356         -245         7106         -           21         6607         225         6840         233         7082         242         730         -         730         -         245         730         -         730         -         -244         736         -243         6564         -         -         -244         736         -243         6564         -         -         -244         736         -243         6564         -         -         -244         736         -243         6564         -         -         -244         736         -243         6564         -         -         -243         6564         -         -         -256         5561         -         -244         7367         -258         7105         -244         7367         -258         6420         -252         64427         -252         64427         -252         64427         -252         6420         -252         7652         -240         6120         -252         7652         -240         6120		18	96430	- 61	6354	- 76	6272		0619	90
20         7836         -214         7601         -235         7356         -245         7106         -           21         6607         225         6840         233         7082         242         7330           22         7298         -213         7061         -237         6818         -243         6564         -           23         4820         230         5060         240         5310         250         5564         -           24         7869         -222         7625         -244         7367         -258         7105           25         5495         230         5732         237         5980         248         6230           26         7180         -222         6940         -240         6688         -252         6427           27         5630         230         5870         240         6120         250         6371           28         7801         -221         7563         -238         7311         -252         7052           29         5922         232         6161         239         64418         257         6672		19	6148	<del>1</del> 9 -	6909	- 79	5983	- 86	5900	0.5
6607         225         6840         233         7082         242         7330           7298         -213         7061         -237         6818         -243         6564         -           7298         -213         7061         -237         6818         -243         6564         -           4820         230         5060         240         5310         250         5561         -           7869         -222         7625         -244         7367         -258         7105           5495         230         5732         237         5980         248         6230           5630         230         5870         -240         6688         -252         6427           7801         -221         7563         -238         7311         -252         7052           5922         232         6161         239         6418         257         6672	1.76	20	7836	-214	1092	-235	7356	-245	2106	
7298         -213         7061         -237         6818         -243         6564         -           4820         230         5060         240         5310         250         5561         -           7869         -222         7625         -244         7367         -258         7105         -           5495         230         5732         237         5980         248         6230         -           7180         -222         6940         -240         6688         -252         6427         -           5630         230         5870         240         6120         250         6371         -           7801         -221         7563         -238         7311         -252         7052         -           5922         232         6161         239         64418         257         6672         -		21	6607	225	0489	233	7082	242	7330	10
4820         230         5060         240         5310         250         5561           7869         -222         7625         -244         7367         -258         7105           5495         230         5732         237         5980         248         6230           7180         -222         6940         -240         6688         -252         6427           5630         230         5870         240         6120         250         6371           7801         -221         7563         -238         7311         -252         7052           5922         232         6161         239         64418         257         6672		22	7298	-213	7061	-237	6818	-243	6564	- 03
7869         -222         7625         -244         7367         -258         7105           5495         230         5732         237         5980         248         6230           7180         -222         6940         -240         6688         -252         6427           5630         230         5870         240         6120         250         6371           7801         -221         7563         -238         7311         -252         7052           5922         232         6161         239         6418         257         6672		23	4820	230	5060	240	5310	250	5561	08
5495         230         5732         237         5980         248         6230           7180         -222         6940         -240         6688         -252         6427           5630         230         5870         240         6120         250         6371           7801         -221         7563         -238         7311         -252         7052           5922         232         6161         239         6418         257         6672	-	<b>'</b> お	7869	-222	7625	-244	7367	-258	7105	02
7180         -222         6940         -240         6688         -252         6427           5630         230         5870         240         6120         250         6371           7801         -221         7563         -238         7311         -252         7052         -           5922         232         6161         239         6418         257         6672         -		25	5495	230	5732	237	5980	248	6230	10
5630         230         5870         240         6120         250         6371           7801         -221         7563         -238         7311         -252         7052         -           5922         232         6161         239         6418         257         6672         -		3	7180	-222	0469	-240	6688	-252	6427	05
7801 -221 7563 -238 7311 -252 7052 - 5922 232 6161 239 6418 257 6672 -		27	5630	230	5870	240	6120	250	6371	60
5922 232 6161 239 6418 257 6672		83	7801	-221	7563	-238	7311	-252	7052	
		. 29	5922	232	1919	239	6418	257	6672	20

Table VII. Original Data



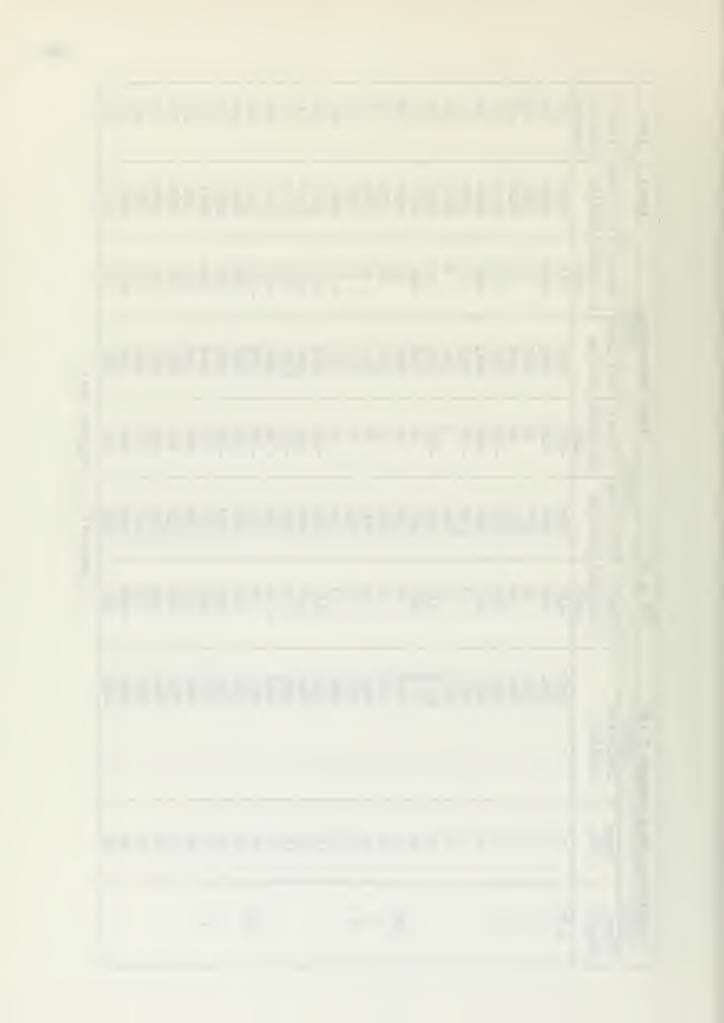
	-	42																												
1,1950	Strain	Increment x106	136	157	- 20	1 32	128	130	5	0	127	123	- 62	92 -	98	66	15	128	167	145	28	220	-218	203	-211	201	-203	195	-194	193
April 1, 3798	Indicator	Reading	5201	5515	7,330	5060	8964	7805	5473	5190	5826	5383	6258	04769	7084	7281	7305	6738	0149	6615	6071	2760	04799	7319	14884	7853	5588	7110	5707	7732
000	Strain	Increment	111	128	- 19	- 29	103	107	10	- 03	107	100	09 -	09 -	75	78	Ħ	102	133	120	62	180	-179	799	-171-	164	-162	191	-159	159
Increasing 2692	Indicator	Reading	9905	5358	4350	5100	047847	14672	2460	5199	5699	5260	6320	2016	8669	7182	7290	6610	6243	0249	5993	7540	6858	7116	5095	7652	5785	6915	5901	7539
Load 55	Strain	Increment x106	108	130	18	- 30	104	106	80	ω 1	102	98	- 52	- 58	77	78	10	104	133	120	19	177	-175	165	-169	165	-160	1.58	-160	159
179	Indicator	Reading	4955	5230	4369	5129	4737	4565	5450	5202	5592	5160	6380	9202	6923	7101	7279	6508	6110	6350	5931	7360	7037	6950	5266	2488	2465	6754	0909	7380
50° = 1° ≤0° = 1° = 1° = 1° = 1° = 1° = 1° = 1° =	Strain	Increment x106	120	123	60	- 52	108	108	39	- 25	105	106	- 34	- 80	82	75	17	111	1,38	121	63	1.83	-179	170	-175	169	-163	162	-160	161
1.5" 90	or		4847	5100	4387	5159	4633	1350	5445	5210	2490	5062	6432	7134	6852	7023	7269	4049	5977	6230	5870	7183	7212	6785	5435	7323	2019	9659	6220	7221
Breadth = 1	Indicator	Reading	4727	4977	4378	5211	4525	4351	5403	5235	5385	4956	9949	721.4	6770	84769	7252	6293	5839	6109	5807	2000	7391	6615	5610	7152	6270	0649	6380	2060
Ring	Gage i	No	7	8	0	7	2	9	2	ω	6	10	11	12	13	14	15	3.6	17	18	19	20	디	22	23	77	25	56	27	დ 2
Stiffening	Cage	Factor	1,80	_		4	-						1.82			3	-					1.76			•					

Table VIII. Original Data



,	_	_		-								_	_	_											-								
, 1950	0	From	Original Reading	13	17	20	18	15	74	17	16	15	16	17	18	15	12	80	16	H	디	10	10	77	12	13	10	1.5	10	15	80	14	
April 1		Indicator	Reading	04/247	4991	4398	5229	4540	4365	5420	5251	2400	4972	08479	7232	6785	0969	7260	6309	5850	6120	5817	7010	2405	6627	5623	7162	6285	01/19	6395	8902	6710	
		Strain	Increment x106	-115	-132	27	31	-105	-109	- 05	ω	-108	-101	19	61	- 72	- 79	- 10	-101	-132	-125	- 67	-183	180	-170	174	-171-	163	-168	163	-163	165	
Decreasing	5906	Indicator	Reading	0984	5115	001717	5170	4650	174471	5452	5220	5502	5078	01719	7144	6863	7032	7270	6412	5988	6245	5883	7199	7220	6801	5445	7339	6113	1199	6229	7237	6540	D. 4.0
Load		Strain	Increment x106	-109	-125	56	34	-104	-105	- 03	0,	-105	96 -	19	63	- 68	- 78	- 10	-101	-139	-120	- 65	-180	186	-169	178	-168	167	-161	166	-162	167	F
	18010	Indicator	Reading	52647	5247	4329	5139	4755	4580	5457	5212	5610	5179	6329	7083	6935	7111	7280	6513	6120	6370	5950	7382	2040	1269	5270	7510	5950	6229	9909	2400	6375	7777
V/5 = .2		Strain	Increment	-117	-143	23	55	-109	-117	- 13	13	-111	-108	09	80	- 81	- 92	- 15	-124	-151	-125	- 56	-198	214	-179	208	-175	195	-170	193	-170	196	E 5 - E
1111		or	80	5084	5372	4353	5105	4859	14685	2460	5203	5715	5275	6318	7020	2003	7189	7290	4199	6259	0649	6015	7562	4589	7140	5092	2678	5783	04769	2900	7562	6208	
Breadth =	27030	Indicator	Reading												name de la constanta de la cons		AAA SAA SAA SAA SAA SAA SAA SAA SAA SAA																
Stiffening Ring B		Gage	No.	7	23	m	4	'n	9	2	ω	0,	10	11	12	r r	14	15	16	17	18	19	20	27	22	গ্ন	77	25	56	27	78 78	29	
Stiffen	Ioad	Gage	Factor	1,80	_		;	>						1.82			>-						1.76			1>							

Table VIII. Original Data



No.   Reading   Indicator   Strain   Indicator   Strain   Indicator   Strain   Indicator   Strain   Indicator   Strain   Indicator   No.   Reading   Increment   Increment	Load	Load	0	1(	5000	2001	0	2998	20		39945
No.   Reading   Increment   Reading   Increment   Reading   2   4740   4450   132   5257   135   5490   4355   135   4397   4443   16   4959   100   4959   100   4355	GARB	Gage	Indicat	or	Strain	Indicator	Strain	Indicator		Strain	Strain Indicator
80         1         4740         4850         110         4959         5122         132         5257         135         5490         5490         5122         132         5257         135         5490         5490         5122         135         5490         135         5490         4095         5122         135         5490         135         5490         135         5490         135         5490         100         5059         100         5059         100         4096         5059         110         4696         1	Factor	No.	Reading		Increment		Increment x106		Inc	Increment	rement Reading
2         4990         5122         132         5257         135         5490           4         4520         4443         16         4384         22         4445           5         4540         4640         100         4740         100         4840           6         4560         4475         110         4786         111         4896           6         4560         4475         100         4786         111         4896           8         5249         5200         100         5500         100         5520           9         5490         5500         100         5188         107         5290           10         4971         5081         100         5188         107         5197           9         5490         5500         100         5188         107         5290           10         4987         5081         100         5188         107         5290           11         6480         6446         -34         6370         -76         6292           12         7227         107         7122         177         107         7289           16 <td>1,80</td> <td>-1</td> <td>04/24</td> <td>4850</td> <td>110</td> <td></td> <td>109</td> <td></td> <td></td> <td>106</td> <td></td>	1,80	-1	04/24	4850	110		109			106	
3         4397         4443         16         4384        29         4355           6         4364         100         4740         100         4840        83         5100        40         5059           6         4365         44475         110         4586         111         4696         111         4696         111         4696         111         4696         111         4696         111         4696         111         4696         111         4696         111         4696         111         4696         111         4696         110         4597        69         5500         0         5197         5220         0         5197         5220         0         5197         5220         0         5197         5220         0         5197        76         6292         0         5197        76         6292         0         5197        76         6292         0         5197        76         6292         0         5197        76         6292         0         5197        76         6292         0         5197        76         6292         0         5197         1007         5197         1007		2	06647	5122	132	5257	135	2490		33	
*82         5140         -83         5100         -40         5059           6         4365         4475         110         4740         110         4696           6         4365         4475         110         4740         110         4696           7         5421         5487         66         5502         15         5520           8         5249         5200         -0         5500         100         4696           9         5400         5500         100         5608         108         5715           10         4971         5081         110         5188         107         5290           11         6480         6446         -34         6370         -76         6522           12         7227         7109         -18         703         -76         6522           13         6480         7068         109         5107         -76         6522           14         6966         7068         109         703         -76         6522           15         7286         7296         107         7299         107         7100           16         6520 </td <td></td> <td>(1)</td> <td>14397</td> <td>4413</td> <td>16</td> <td>4384</td> <td>~ 29</td> <td>4355</td> <td></td> <td>63</td> <td></td>		(1)	14397	4413	16	4384	~ 29	4355		63	
\$ \frac{4540}{4540} \text{ \text{total bounds}}{4475} \text{ \text{110}} \text{ \text{total bounds}}{4586} \text{ \text{111}} \text{ \text{total bounds}}{4586} \text{ \text{111}} \text{ \text{total bounds}}{4586} \text{ \text{111}} \text{ \text{total bounds}}{4580} \text{ \text{110}} \text{ \text{total bounds}}{4580} \text{ \text{110}} \text{ \text{total bounds}}{5500} \text{ \text{110}} \text{ \text{ \text{total bounds}}{5500} \text{ \text{110}} \text{ \text{ \text{total bounds}}{5500} \text{ \text{ \text{total bounds}}{5		14	5223	5140	- 83	5100	- 40	5059	小 -	크	
6         4365         4475         110         4586         111         4696           7         5421         5487         66         5502         15         5520           9         5249         5200         - 49         5200         0         5197           10         4971         5801         110         5608         107         5715           11         6480         5600         100         5715         5290         5197           12         7227         7109         -18         7033         - 76         6292           14         6960         7068         107         7175         107         7283           15         7258         7274         16         6799         107         7283           16         6510         6463         108         7175         107         7283           16         6510         6463         153         6610         147         6756           16         6510         6463         153         6510         147         6756           16         6510         6463         175         124         6776         147         6780	-	N	4540	14640	100	0424	100	0484	10	0	
7         5421         5487         66         5502         15         5520           9         5249         5200         - 49         5200         0         5197           10         4971         5081         110         5608         108         5715           11         6480         6446         - 34         6370         - 76         599           12         7227         7109         -118         7033         - 76         6960           14         6960         7068         107         7283         - 76         6960           15         7227         7109         -118         7033         - 76         6960           16         6310         5463         107         7283         - 70         529           16         6310         5463         107         7283         - 71         6960           16         6310         5463         117         6500         107         7283           16         6310         5463         117         6500         114         7730           18         6120         6245         125         6200         175         6500		10	4365	1425	110	4586	111	9694	110	0	
8 5249 5200 - 49 5200 0 5197  10 4971 5081 110 5188 107 5290  11 6480 6446 - 34 6370 - 76 6292  12 7227 7109 -118 7033 - 76 6960  13 6785 6892 107 7283 - 76 6960  14 6960 7068 108 7175 107 7283  15 7258 7274 16 7295 107 7283  16 6310 6487 153 6610 147 6756  17 5850 6025 175 6200 175 6371  18 6120 6245 125 6372 127 6500  19 5815 5860 45 5906 46 5990  22 6623 6747 124 6879 132 6989  23 5625 5492 -140 7122 -143 6980  24 7160 7278 118 7392 114 7509  25 6285 6580 -110 6661 111 6770  26 6439 6520 -113 6650 -113 6650  27 6396 6283 -113 6481 -113 6481 -116 6368		~	5421	5487	99	5502	15	5520	18	~	5535
9         5400         5500         100         5608         108         5715           10         4971         5081         110         5188         107         5290           12         7227         7109         -118         7033         - 76         6922           13         6785         6892         107         6999         107         7283           14         6960         7274         108         7175         107         7283           15         7258         7274         108         7175         107         7283           16         6310         6463         153         6610         147         6756           16         6310         6463         153         6610         147         6756           16         6310         6463         153         6610         147         6756           17         5850         6025         175         6206         147         6756           18         6120         6245         142         7296         146         7296         147         6756           19         5815         5860         445         5806         445		0	5249	5200	64 -	5200	0	51.97	- 03		
*82         10         \$4971         \$681         110         \$589         107         \$5290           *82         11         \$6480         \$6446         - 34         \$5370         - 76         \$5290           12         7227         7109         -118         7033         - 76         \$6292           13         \$6785         \$6392         107         \$6999         107         726         \$6292           14         \$6960         7068         108         7175         107         7283         710 </td <td></td> <td>6</td> <td>5400</td> <td>5500</td> <td>100</td> <td>5608</td> <td>108</td> <td>5715</td> <td>107</td> <td>_</td> <td></td>		6	5400	5500	100	5608	108	5715	107	_	
*82 11 6480 6446 -34 6370 -76 6292  12 7227 7109 -118 7033 -76 6960  13 6785 6892 107 6999 107 7283  14 6960 7068 108 7175 107 7283  15 6310 6463 153 6610 147 6756  19 5815 5860 45 5906 46 5901  19 5815 5860 142 7290 140 7430  22 6623 6747 124 6879 132 6989  23 5625 5492 -140 7122 -143 6989  24 7160 7278 118 7392 114 7509  25 6285 6166 -119 6050 -116 5770  27 6396 6283 -119 6050 -116 6770  28 7065 7178 113 7289 111 7397  29 6710 6597 -113 6170 -113 6170 -115		10	17971	5081	110	5188	107	5290	102		wood or a
12       7227       7109       -118       7033       - 76       6960         13       6785       6892       107       6999       107       7283         14       6960       7068       108       7175       107       7283         15       7258       7274       16       7295       21       7314         16       6310       6463       153       6610       147       6756         16       6310       6463       153       6620       175       670         18       6120       6245       175       6200       175       670         18       6120       6245       125       6200       175       670         19       5815       5860       445       5906       46       5951         20       7008       7150       140       7122       140       7430         21       7405       7265       -140       7122       140       7509         22       5625       5492       -133       5363       -129       523         24       7160       7278       118       7392       -119       66050	- 8	11	6480	9759	- 34	6370	- 76	6292	- 78		
13       6785       6892       107       7100         14       6960       7068       108       7175       107       7283         15       7258       7274       16       7295       21       7314         16       6310       6463       153       6610       147       6756         17       5850       6025       175       6200       175       6371         18       6120       6245       125       6520       175       6570         19       5850       6225       175       6500       175       6500         20       7008       7150       142       7290       140       7430         21       7405       7265       -140       7122       -143       6980         22       6623       6747       124       6879       132       6980         23       5625       5492       -133       5363       -129       5233         24       7160       7278       118       7392       114       7509         25       6439       6550       -116       6650       -116       6770         28       7065       <	-	12	7227	7109	-118	7033	92 -	0969	- 73		
14         6960         7068         108         7175         107         7283           15         7258         7274         16         7295         21         7314           16         6310         6463         153         6610         147         6756           17         5850         6025         175         6200         175         6756           18         6120         6245         125         6372         127         6500           19         5815         5860         45         5906         46         5951           20         7008         7150         142         7290         140         7430           21         7405         7265         -140         7430         140         7430           22         6623         6747         124         6879         132         6989           23         5625         5492         -133         5363         -129         5233           24         7160         7278         118         7392         114         7509           25         6439         6550         -119         6661         111         6770		13	6785	6892	107	6669	107	2100	101		7202
15     7258     7274     16     7295     21     7314       16     6310     6463     153     6610     147     6756       17     5850     6025     175     6200     175     6756       18     6120     6245     125     6372     127     6500       19     5815     5860     45     5906     46     5951       20     7008     7150     142     7290     140     7430       21     7405     7265     -140     7430     140     7430       22     6623     6747     124     6879     132     6989       23     5625     5492     -140     7899     114     7509       24     7160     7278     118     7392     -129     5233       25     6439     6550     -119     6050     -116     6770       26     6439     6550     -113     6170     -113     6368       29     6710     6597     -113     6481     -116     6368		77	0969	7068	108	7175	107	7283	108		7390
16         6310         6463         153         6610         147         6756           17         5850         6025         175         6200         175         6371           18         6120         6245         125         6372         127         6500           19         5815         5860         45         5906         46         5951           20         7008         7150         142         7290         140         7430           21         7405         7265         -140         7430         140         7430           22         6623         6747         124         6879         132         6989           23         5625         5492         -133         5363         -129         5233           24         7160         7278         118         7392         114         7509           25         6439         6550         -119         6050         -116         6770           28         7065         7178         113         6481         -115         6481         -116         6368		15	7258	7274	16	7295	21	7314	1.9		7331
17       5850       6025       175       6200       175       6371         18       6120       6245       125       6372       127       6500         19       5815       5860       45       5906       46       5951         20       7008       7150       142       7290       140       7430         21       7405       7265       -140       7122       -143       6980         22       6623       6747       124       6879       132       6980         22       6623       6747       124       6879       132       6980         23       5625       5492       -133       5363       -129       5233         24       7160       7278       118       7392       114       7509         25       6285       6166       -119       6050       -116       6770         27       6396       6283       -113       6170       -113       6059         28       7065       7178       113       6481       -116       6568         29       6710       6597       -113       6481       -116       6669		16	6310	64463	153	0199	147	6756	178		6900
18         6120         6245         125         6372         127         6500           19         5815         5860         45         5906         46         5951           20         7008         7150         142         7290         140         7430           21         7405         7265         -140         7122         -143         6980           22         6623         6747         124         6879         132         6989           23         5625         5492         -133         5363         -129         5233           24         7160         7278         118         7392         114         7509           25         6285         6166         -119         6050         -116         5935           26         6439         6550         111         6661         111         6770           27         6396         6283         -113         6481         -113         6481         -113           29         6710         6597         -113         6481         -116         5367		17	5850	6025	175	6200	175	6371	171		44759
19       5815       5860       45       5906       46       5951         20       7008       7150       142       7290       140       7430         21       7405       7265       -140       7122       -143       6980         22       6623       6747       124       6879       132       6980         23       5625       5492       -133       5363       -129       5233         24       7160       7278       118       7392       114       7509         25       6285       6166       -119       6050       -116       5935         26       6439       6550       111       6770       -113       6059         28       7065       7178       -113       6481       -116       6368         29       6710       6597       -113       6481       -116       6368		18	6120	6245	125	6372	127	6500	128		6628
20         7008         7150         142         7290         140         7430           21         7405         7265         -140         7122         -143         6980           22         6623         6747         124         6879         132         6989           23         5625         5492         -133         5363         -129         6989           24         7160         7278         118         7392         114         7509           25         6285         6166         -119         6050         -116         5935           26         6439         6550         111         6770         -113         6059           28         7065         7178         113         7289         111         7397           29         6710         6597         -113         6481         -116         6368		19	5815	5860	无	9065	3	5951	45		0009
7405         7265         -140         7122         -143         6980           6623         6747         124         6879         132         6989           5625         5492         -133         5363         -129         5233           7160         7278         118         7392         114         7509           6285         6166         -119         6050         -116         5935           6439         6280         -113         6170         -113         6059           7065         7178         113         7289         111         7397           6710         6597         -113         6481         -116         6368	1.76	20	7008	7150	142	7290	071	7430	149		7570
6623         6747         124         6879         132         6989           5625         5492         -133         5363         -129         5233           7160         7278         118         7392         114         7509           6285         6166         -119         6050         -116         5935           6439         6550         111         6661         111         6770           6396         6283         -113         6170         -113         6059           6710         6597         -113         6481         -116         6368		お	7405	7265	-140	7122	-125	0869	-145		6839
5625       5492       -133       5363       -129       5233         7160       7278       118       7392       114       7509         6285       6166       -119       6050       -116       5935         6439       6550       111       6661       111       6770         6396       6283      113       6170       -113       6059         7065       7178       113       7289       111       7397         6710       6597       -113       6481       -116       6368		22	6623	2429	124	6839	132	6869	110		7110
726         7278         118         7392         114         7509           6285         6166         -119         6050         -116         5935           6439         6550         111         6661         111         6770           6396         6283         -113         6170         -113         6059           7065         7178         113         7289         111         7397           6710         6597         -113         6481         -116         6368		62	5625	5492	-133	5363	-129	5233	-130		5108
6285         6166         -119         6050         -116         5935           6439         6550         111         6661         111         6770           6396         6283         -113         6170         -113         6059           7065         7178         113         7289         111         7397           6710         6597         -113         6481         -116         6368		24	2160	7278	118	7392	114	7509	117		7621
6439         6550         111         6661         111         6770           6396         6283        113         6170         -113         6059           7065         7178         113         7289         111         7397           6710         6597        113         6481        116         6368		252	6285	9919	-119	6050	-116	5935	-115		5820
6396         6283         -113         6170         -113         6059           7065         7178         113         7289         111         7397           6710         6597         -113         6481         -116         6368		56	6439	6550	111	1999	111	6770	109		Pringa coma
7065         7178         113         7289         111         7397           6710         6597         -113         6481         -116         6368		27	6396	6283	-113	6170	-113	6909	-111		5948
6710 6597 -113 6481 -116 6368		28	7065	7178	113	7289	111	7397	108		7504
		53	6710	6597	-113	18479	-116	6368	-113		6253

Table VIII, Uriginal Data

Stiffening	Ring	Breadth = $1\frac{1}{2}$ "	T/C = .35	5	Load	Decrea	9.0	April 1,	, 1950
Load		30030		20010	10	1001	5.1		0
Gage	රිපළි	Indicator	Strain	Indicator	Strain	Indicator	Strain	Indicator	From
Factor	No.	Reading	Increment x106	Reading	Increment	Reading	Increment x10 <sup>6</sup>	Reading	Original Reading
1,80	٦	5072	- 98	4970	-102	09847	-110	<b>ተ</b> ከረተ	1,0
	~	5396	-127	5267	-129	5130	-137	t766th	70
	<i>س</i>	4359	30	4390	31	4418	28	1701/1	20
-	4	5060	45	5102	42	5143	47	5230	20
	2	6484	06	4753	96 -	1650	-103	9454	90
	9	00247	-104	74596	-104	4481	-115	4370	05
	2	5520	- 15	5502	- 18	2490	- 12	5429	98
	∞	5198	80	5200	02	5204	170	5256	20
	0	5722	COT~	5620	-102	5509	-111	5401	10
	10	5298	% -	5200	- 98	5090	-110	4978	02
1,82	11	6286	68	4969	78	171719	8	6485	0.5
-	12	17969	29	7037	23	711.1	472	7236	60
	13	7103	- 99	2000	~103	2689	-103	6849	40
- Z	17	7282	~108	2176	-1.06	2070	-106	6965	05
	7,7	7310	ـ 22	7290	- 20	7273	- 17	7260	02
	16	6755	-145	6610	-145	6465	-145	6312	02
	17	6378	-166	6210	-168	6033	-177	5854	40
	1.8	6510	-118	6390	-120	6259	-131	6120	00
,	1.9	5965	- 38	5923	- 39	5872	- 51	5820	0.5
1.76	8	5443	-127	7310	-133	7163	-147	7010	02
	72	0869	141	7121	141	7270	149	7411	90
	22	0069	-110	6889	-111	0929	-129	6628	92
>	23	5232	ेंहत	5362	130	5495	133	5630	05
	たる	7520	-101	7414	-106	7291	-123	7165	05
	25	5934	114	6050	116	6170	120	6291	90
	56	6785	- 95	6682	-103	9959	-116	C447	02
	27	6057	109	6170	113	6285	115	6401	05
	28	2410	t6 -	7310	-100	1612	-119	7070	05
	53	6367	114	0949	113	6299	119	6718	80
			E	100000					

Table VIII, Original Data

1,950		Strain	Increment	109	141	- 36	1 36	100	11.5	20	Н	113	111	- 91	- 85	128	132	56	180	204	136	33	118	-122	2	-103	48	- 89	62	- 86	22	ŭ
April I.	0,000	or	Reading I	5181	5561	4354	8264	4947	483	5582	5192	5845	5429	6173	6837	7310	2488	7362	2045	9299	9999	5963	7847	6930	2003	5218	7501	5941	6763	0209	7383	7007
	- [		Increment x106	105	140	9-1	1 55	66	115	19	<del>را</del> ا	112	108	- 91	98 -	124	130	25	177	202	132	37	971	-119	22	-103	85	- 87	78	178 -	27	000
Increasing	107	Indicator	Reading	5072	5420	4360	5024	2484	4718	5562	5191	5732	5318	6264	6922	7182	7356	7336	6865	6472	6530	5930	7366	7052	6910	5321	7417	6030	<b>1</b> 899	6156	9062	717
Load		Strain	Increment x106	107	170	134	- 50	66	113	19	0	110	110	- 92	-183	126	130	25	178	200	134	35	118	-121	75	-104	82	- 86	78	- 82	22	000
1000		Indicator	Reading	4964	5280	0044	5070	8424	14603	5543	5192	5620	5210	6355	2008	7058	7226	7311	6688	6270	6398	5893	7250	1212	6817	5424	7332	6117	9099	6240	7229	777
5' = 9/2	2,2	S ಕನ್ನಡನ್ನು	Increment x106	110	147	77	-113	66	11.9	92	89 -	103	120	- 38	64 -	134	126	22	192	210	138	35	122	-121	88	-107	89	- 91	85	178 -	85	02
127	of the state of th	tor	80	74860	5140	4544	5120	617917	06174	5524	5192	5510	5100	2449	7191	6932	9602	7286	6510	0209	4929	5858	7132	7292	6723	5528	7250	6203	6528	6322	71.52	6677
Breadth = 1	-1	Indicator	Reading	4750	6664	1410	5233	4550	4371	5432	5260	2075	08647	6485	7240	8629	0269	7264	6318	5860	6126	5823	2010	7413	6625	5635	7161	4629	6443	90179	2902	4720
Ring		Gage	No.	en!	2	3	, 4	5	9	2	ω	6	07	11	12	13	14	15	16	17	18	13	82	17	22	23	42	25	56	27	788	000
Stiffening	TOSC.	රිප්රීල	Factor	1.80		;	•							1,82			>						1.76			>						

Table VIII. Original Data

	1			_	_																						_					
1,1950	0	From	Original Reading	00	- 01	10	03	00	01	03	03	- 01	02	02	40	00	00	00	02	00	00	03	03		02	01	02	0 5	40	02	03	02
April 1,	0	Indicator	Reading	4750	86647	447.1	5236	4550	4372	5435	5263	2406	4982	28479	7244	8649	0269	7264	6320	5860	6126	5826	7013	7417	2299	5630	7163	6299	2449	80179	7070	6722
		Strain	Increment x105	-108	-140	35	27	-100	-116	- 23	<u>ش</u>	-114	-109	16 -	87	-128	-130	- 25	-180	-205	-135	- 33	-119	124	- 95	105	- 85	88	- 80	85	- 78	84
Decreasing	11030	Indicator			5143	01717	5122	1,656	74762	5525	5193	5513	5108	9449	9602	6932	7095	7283	6507	6072	6273	5870	7143	7294	6735	5528	7263	6205	6540	6323	7165	4699
Load	30	Strain	Increment x106	-105	-137	35	51	% -	-112	82 -	73	-109	901-	- 92	3,5	-128	-129	- 25	-177	-199	-130	- 32	-112	120	- 89	103	- 78	88	- 3	98	- 72	85
	22090	Indicator	Reading	4975	5283	4405	5071	4756	4608	5548	5190	5627	5217	6352	2009	0902	7225	7308	6687	6277	80479	5903	7262	7170	6830	5423	2348	6117	6620	6238	7243	6550
2/6= .5		Strain	Increment x106	101-	-141	\$	745	- 95	-113	- 14	7 -	-109	-106	- 87	87	-122	-134	- 29	-181	-200	-128	- 28	-110	120	- 84	102	- 75	88	- 70	82	- 68	င္တ
1,21	N	tor	₽Đ	5080	5420	4370	5020	4852	4720	5568	51.88	5736	5323	6260	4269	7188	7354	7333	4989	9249	6538	5935	73.74	2050	69169	5320	2426	6059	6693	6152	7315	9465
Breadth =	1 3301	Indicator	Reading																													
Stiffening Ring I		Gage	No	7	23	3	4	3	9	~	ω	0	10	77	7.5	13	14	15	16	17	18	19	02	27	22	23	77	25	56	27	82	29
Stiffer	Load	Gage	Factor	1.80	_		>							1,82			>					,	1.76									

Table VIII, Original Data



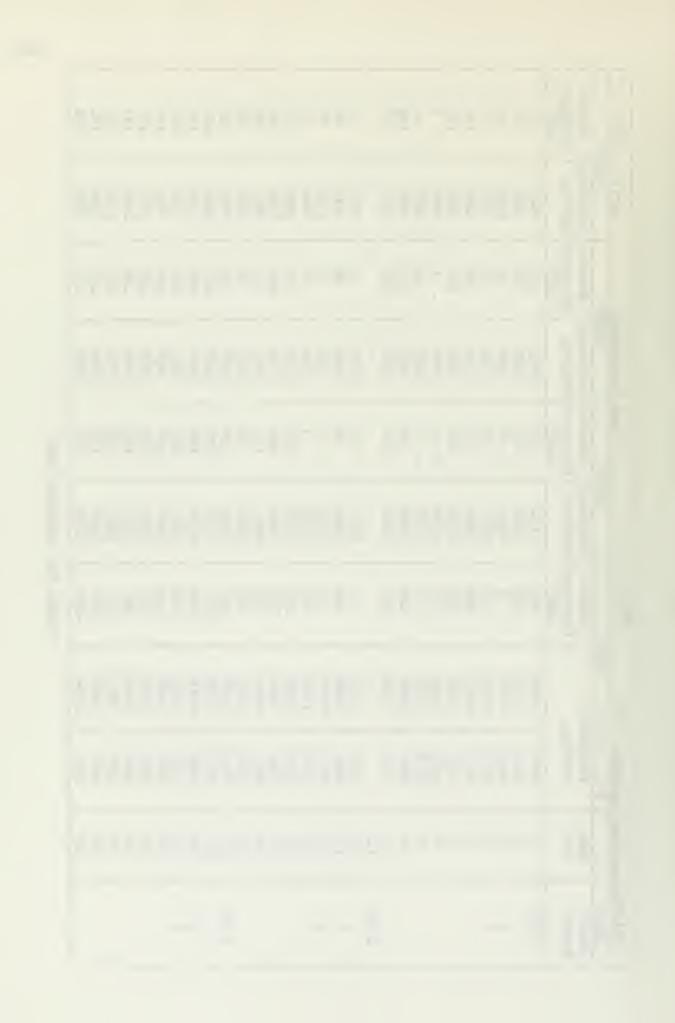
			t t																														
1950		Strain	Increment	26	88	12	- 11	89	<del>1</del> 8	ω	- 22	25	72	14	- 32	- 15	10	2	77 -	32	778	88	235	-238	236	-242	ट्य	-243	11/2	-245	240	-245	
April 1,1950	08664	Indicator	Reading	5120	5370	4420	5191	4064	8894	5409	5188	5705	5260	6504	7138	0429	6992	7254	6292	5960	4549	61.55	7952	2449	7568	14633	8144	5300	7417	2045	8032	5705	
50	90	Strain	Increment x106	85	89	2	- 16	87	472	2 -	- 20	20	89	Ŋ	- 25	11 -	ω	0	1 2	18	89	74	229	-235	233	-245	242	-241	252	-243	241	-245	
Increasing	32990	Indicator	Reading	5023	5272	14408	5202	4815	4094	5401	5210	5630	5188	2490	7170	6755	6982	7256	9629	5928	6350	2909	7722	0899	7332	4875	7901	5543	27.73	2495	7792	5950	
Load	20	Strain	Increment x106	%	16	n	6	8	29	7	- 15	92	20	7	- 22	- 12	9	m	۳ ا	82	79	జ	234	-237	237	-243	248	-243		-245	241	-249	1 Data
ng	21850	Indicator	Reading	4938	5183	104401	5218	4728	4530	5408	5230	5560	5120	6485	7195	9929	4269	7256	6301	5910	6282	5993	2493	6915	7099	5120	7659	5784	6921	5890	7551	6195	[. Original
Pure Bending	090	Strain	Increment x106	66	8	2	- 2	%	8	4 -	6 1	81	22	2	- 17	9 -	4	m	4 -	53	81	87	239	-247	237	-247	6472	-245		-246	242	-249	Table VIII.
131	09601	tor	20	74847	5092	4398	5227	4638	4451	5413	5245	5484	5050	08179	7217	6778	8969	7253	6303	5882	6203	5910	7259	7152	6862	5363	7411	6027		6135	7310	17/119	
Ring Breadth = 1	0	Indicator	Reading	4743	6664	4391	5229	4542	4368	5417	5254	5403	4977	8449	7234	4849	6962	7250	6307	5853	6122	5823	7020	7393	6625	5610	7162	6272	8649	6381	2068	6699	
		Gage	No.	-	2	<u></u>	4	2	9	2	ω	0	10	11	12	13	14	15	76	17	18	19	20	72	22	ম	77	25	%	27	83	29	
Stiffening	Load	Gage	Factor	1,80			~							1.82									1.76			-							

950		From	Original Reading	10	60	17	174	15	12	16	15	14	12	12	14	16	5	12	13	80	80	60	10	17	02	18	80	17		18	02	
April 1,1950	0	Indicator	Reading 0.	4753	5008	14708	5243	4557	4380	5433	5269	5417	6864	0649	7248	6800	6975	7262	6320	5861	6130	5832	7030	7410	6632	5628	7170	6289	6451	6389	2025	
	00	Strain	Increment x	-102	- 99	0	10	96 -	98 -	0	15	ا ج	92 -	4	25	12	<u>س</u> ا	ν,	2	- 29	- 89	- 91	242	245	245	252	258	242	255	251	255	
Decreasing	11080	Indicator	Reading	0984	5106	44107	5234	4657	17974	5420	5253	5500	7905	6485	7225	6792	0869	7261	6315	5894	6220	5928	7278	2160	9889	5372	7435	6034	6713	6142	7332	
Load	10	Strain	Increment x106	- 88	- 87	ı	15	178 -	- 72	9	27	- 67	- 63	9	29	15	1	Н	co	- 23	- 71	- 75	-226	242	-229	248	-237	242	-232	6472	-233	
	2201	Indicator	Reading	79647	5205	4410	5228	4753	4550	5411	5238	5583	5140	6481	7200	6780	6983	7256	6308	5923	6309	6009	7524	6915	7131	5120	7693	5787	8969	5891	7587	
Pure Bending		Strain	Increment x106	- 70	- 78	6 -	22	- 67	- 66	47 -	29	- 55	- 57	- 17	33	25	7 -	Н	ω	- 14	- 54	- 61	-207	231	-208	239	-214	240	-217	240	-212	
Breadth = 13"	33075	Indicator	Reading	5050	5292	4411	5213	14837	1622	5405	5217	5650	5203	2849	1717	6969	8869	7255	90069	9465	6380	4609	7750	6439	7360	4872	7930	5540	7200	2495	7820	
Stiffening Ring Bre		Gage	No.	Н	7	c	1-2	. N	. 0	2	ω	0	10	디	12	13	14	15	16	17	18	19	50	72	22	53	77	55	92	27	28	
Stiffen	Load	Gage	Factor	1,80	_		>							1,82	-		>						1.76									

Table VIII. Original Data

	0	905	90	17940	Q	26900	00	38005	15
Gage	Indicator	tor	Strain	Indicator	Strain	Indicator	Strain	Indicator	Strain
No.	Reading	<b>ኒ</b> ስ	Increment x10 <sup>6</sup>	Reading	Increment x106	Reading	Increment	Reading	Increment x106
7	14641	5062	121		110	5285	113	5426	141
7	5190	5323	133	5450	127	5580	130	5240	160
3	4619	4612	2	4585	- 27	4560	- 25	4530	- 30
4	5438	5392	947 -	5355	- 37	5320	- 35	5277	- 43
N	4750	4879	129	5000	121	5120	120	5270	150
9	4557	74680	123	4792	112	4908	116	5051	143
2	5631	5652	21	5650	- 2	64795		9648	· -i
ω	5469	5448	- 21	5435	- 13	5423	- 12	5409	- 14
0	5600	5720	120	5830	110	5943	113	6081	138
10	5191	5306	115	5412	106	5521	109	5657	136
11							,		•
12	7310	7239	- 71	7179	09 -	7120	- 59	2045	- 75
13	0989	6926	99	4869	58	4402	09	7118	42
14	7013	4602	81	8912	42	7241	73	7336	95
15	7342	7360	18	7373	13	7385	12	2400	15
16	6377	6508	131	6628	120	6750	122	0069	150
17	5894	ty909	170	6225	161	6389	164	6590	201
18	6181	6340	159	1649	151	6643	152	6831	188
19	5845	5923	81	5999	92	6075	92	6171	96
20	7073	7258	185	7432	174	2092	175	7823	216
21	7220	2045	-175	9989	-179	6899	-177	8949	-221
22	<u>++++9</u>	6612	168	6772	160	6932	160	7130	198
23	5423	5255	-168	5085	-170	4915	-170	4707	-208
54	6975	2140	165	7300	160	7458	158	7655	197
25	4609	5936	-158	5776	-160	5618	-158	5422	-196
56	6259	6420	161	6573	153	6229	156	6920	191
27	6200	6043	-157	5884	-159	5729	-155	5534	-195
28	0889	2043	160	7190	150	7345	155	7536	191
53	6513	カンとソ	160	Lach	071	7007	011	0.701	70'5

Table IX. Original Data



-		1				_																										
1950		From	Original Reading	- 01	8	02	40	02	02	03	03	00	63	1	00.5	700	20	೮	05	05	10	S	- 01	සු	00	20	03	8	00	S	00	20
April 3,	0	Indicator	Reading	0464	5190	4621	5442	4752	4559	5634	5472	2600	5194	1	7315	7000	7015	7345	6329	5899	1619	5845	7072	7228	4449	5430	8269	0019	6259	6203	6880	6520
5.0	30	Strain	Increment x106	-119	-135	56	33	-127	-120	2	14	-119	-110	,	10	7,0	c) =	11 -	-119	-161	-153	- 82	-181	182	-165	170	-165	162	-161	159	-157	160
Decreasing	9120	Indicator	Reading	17905	5323	4610	5391	4883	08947	6495	5448	5721	5310	0	7230	2002	160%	7356	6507	6909	6356	5930	7262	2044	6619	5251	2149	5935	6428	0409	2048	6351
Load	0	Strain	Increment x106	-118	-133	56	35	-126	-119	2	6	-118	-112	{	52	200	0.1	- 13	-122	-170	-157	98 -	-183	179	-167	170	-166	158	-161	157	-161	159
	1801	Indicator	Reading	5183	5458	4584	5358	5010	4800	2644	5434	5840	2450	8	7175	1000	(T00	7367	9299	6230	6209	6012	243	6862	4849	5081	7314	5773	6589	5881	7205	1619
1/6 = 2		Strain	Increment x106	-125	-149	28	\$	-134	-132	9	16	-123	-125		5.5	27	1 74	- 20	-152	-190	-165	- 73	-197	21.5	-179	204	-175	193	-170	190	-170	192
3/4"	0	or	50	5301	5591	4558	5323	5136	4919	2642	5425	5958	5532		7118	7 2 2 2	240)	7380	8429	0049	9999	8609	7626	6683	6951	4911	2480	5615	6750	5724	7366	6032
Breadth = 3	26980	Indicator	Reading																													
Ring		Gage	No.	7	2	m	4	ν,	9	2	Φ	0	01 5	11.	77	J ;	14	15	16	17	18	19	20	21	22	23	72	25	92	27	88	29
Stiffening	Load	Gage	Factor	1.80	_		-						C	70°T			>						1.76	_		>						

Table IX. Original Data

1										_			-						-													_
, 1950	l VO	Strain	Increment x106	107	134	30	1 43	122	121	∞	6	123	120		- 72	91	108	22	174	214	162	28	138	-139	116	-122	111	-109	107	-105	107	-108
April 4,	3995	Indicator	Reading	5373	5734	4530	5230	5242	5053	5698	2404	8609	5673		1869	7221	2450	7432	2093	6758	6892	0209	7631	6999	6911	4920	7412	2649	6299	5767	7297	6072
5.0	80	Strain	Increment	111	138	30	- 45	123	125	9	6	126	118		- 75	8	109	23	179	217	170	090	141	-141	122	-128	111	-112	109	-109	107	-111
Increa	29980	Indicator	Reading	5266	2600	4560	5273	5120	4932	2690	5413	5975	5553		7053	7130	7342	7410	6169	6544	6730	6012	2493	6802	6795	5042	7301	5758	6572	5872	2190	6180
Load	01	Strain	Increment x106	105	1.32	- 30	主	121	121	∞	∞ i	123	116		- 73	88	103	22	173	210	159	052	133	-138	113	-125	108	-110	102	-109	66	-109
.35	19910	Indicator	Reading	5155	5462	4590	5318	1664	4807	5684	5452	6485	5435		7128	2040	7233	7387	6740	6327	6560	5952	7352	6943	6673	5170	7190	5870	64463	5981	7083	6291
14 m	00	Strain	Increment x106	110	138	2	- 73	121	126	36	97	123	121		-109	۲6	108	20	184	217	167	057	141	-139	120	-127	111	-114	108	-110	107	-113
3/4"	10100	or	80	5050	5330	14620	5362	14876	9894	5676	5430	5726	5319		7201	6951	7130	7365	6567	6117	6401	5900	7219	7081	6560	5295	7082	5980	6361	0609	4869	0049
Breadth = 3	0	Indicator	Reading	0464	5192	4622	5435	4752	4560	2640	5470	5603	5198		7310	6860	7022	2345	6383	2900	6234	5843	2078	7220	04749	5452	6971	7609	6253	6200	6877	6513
Ring		Gage	No.	7	2	m	1	7	9	2	∞	0,	10	11	12	13	14	15	16	17	18	19	20	21	22	భ	お	25	8	27	82	53
Stiffening	Load	ваде	Factor	1.80	_		->	•						1.82			-						1.76			-						

Table IX. Original Data

1						_						_					_																
1950		From	Original Reading	8	- 01	80	05	10 -	8	8	క్ర	- 01	8		20	01	- 05	ర్ధ	- 01	- 33	- 01	_ 01	- 03	10	8	80	- 01	20	05	95	- 05	90	
April 4,	)	Indicator	Reading	0464	5191	14630	5440	4751	4560	2640	5473	5602	5198		7317	6861	7020	7348	6382	5897	6233	5842	2025	7230	04/19	5430	0269	1019	6255	6205	6875	6519	
5.0	٠ 9	Strain	Increment x106	-112	-140	8	847	-129	-126	2	10	-130	-123		25	06 -	-106	- 19	-177	-218	-171	- 63	-145	144	-124	130	-117	115	-115	113	-113	113	
Decreasing	04001	Indicator	Reading	5058	5333	4623	5368	7884	0694	5677	5433	5731	5322		7205	6950	7128	7363	6563	6117	6411	5910	7226	7089	6571	5300	4602	5985	6373	6095	4669	6405	
Load	)O	Strain	Increment x106	-102	-128	31	45	-118	-117	ω .	10	-119	-113		42	- 90	-106	- 23	-175	-210	-157	- 50	-130	141	-109	123	-101	110	- 95	109	16 -	110	Data
.35	20000	Indicator	Reading	5170	5473	4593	5320	5011	4816	5682	5423	5861	5445		7130	2040	7234	7382	0429	6335	6582	5973	7371	9469	6695	5170	7211	5870	98479	5982	7107	6292	Original
1/6=		Strain	Increment x106	-101	-133	32	45	-113	-120	ω 1	0,	-118	-115		25	- 91	-110	- 27	-178	-213	-153	247 -	-130	141	-107	127	-100	111	96 -	901	96 -	110	Table IX.
3/4"	0	cor	50	5272	5601	4562	5275	5129	4933	2690	5413	5980	5558	,	7056	7130	7340	2405	6915	6545	6239	6023	7501	4089	4089	5047	7312	5760	6583	5873	7201	6182	
1 1	1 29910	Indicator	Reading																														
Stiffening Ring B		Gage	No.	Н	2	3	7	<i>v</i>	9	2	ω	0	10	11	12	13	14	15	91	17	18	19	20	21	22	23	お	25	56	27	82	29	
Stiffen	Load	Gage	Factor	1.80	_									1.80		>							1.76	-									

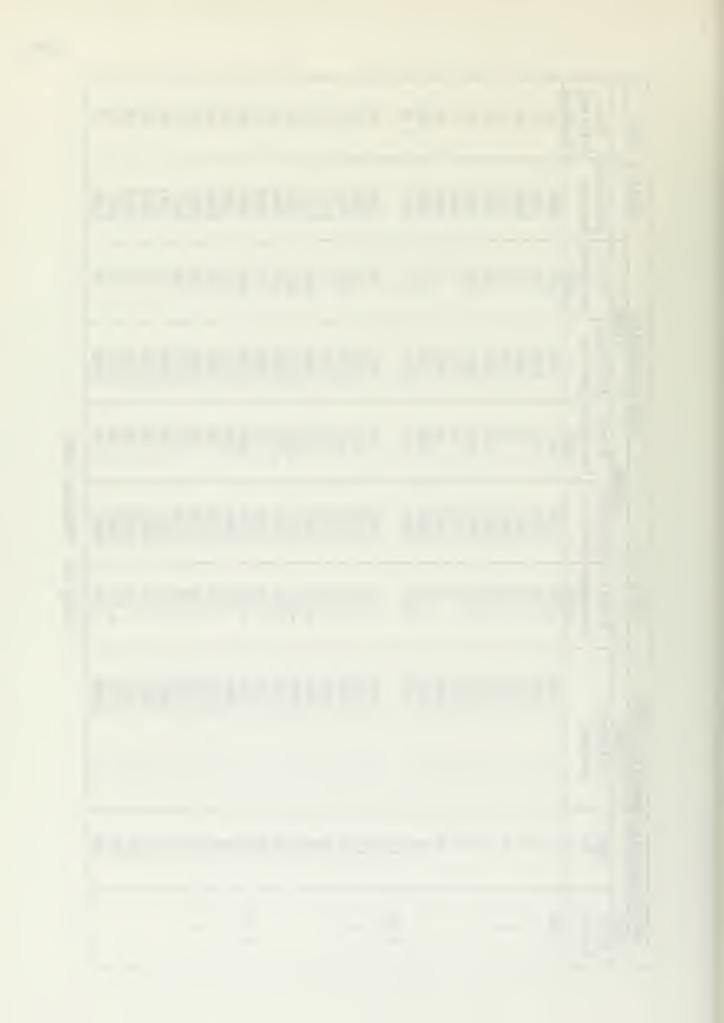
					_				-				-	_	_	_																_
1950	35	Strain	Increment x106	29	83	- 27	- 31	78	83	9	9	85	80		- 53	73	83	18	136	191	110	30	73	- 75	59	- 63	52	- 52	43	- 51	745	- 50
April 4,	3999	Indicator	Reading		5205	4533	5209	5205	5033	5728	5403	6085	5661		2969	7276	2495	7457	7185	6822	6880	0009	7493	6795	6770	5068	7258	5800	6522	5921	7142	6230
5.0	00	Strain	Increment x106	103	139	2	- 50	122	127	2	オー	130	124		16 -	103	115	19	209	647	170	75	111	-120	89	- 99	26	178 -	46	- 78	77	- 80
Increasing	32900	Indicator	Reading	5254	5618	4560	5240	5127	4950	5722	2409	0009	5581		7015	7203	7412	7439	6402	1999	6770	5970	7420	6870	6711	5131	7206	5852	5429	5972	2700	6280
Load	06	Strain	Increment x106	102	143	- 38	- 52	125	132	12	~	134	127		- 72	120	1,52	745	230	260	180	39	115	-119	8	-100	2	- 82	47	- 29	75	- 80
2,	2199	Indicator	Reading		5479	0094	5290	5005	4823	5715	5413	5870	5457		7109	2100	7297	7420	0489	6412	0099	5928	7309	0669	6622	5230	7130	5936	6405	6050	7029	6360
2/6 = 3/3	0	Strain	Increment x106	109	136	ω	- 98	128	132	63	- 53	132	133		-137	115	131	53	226	252	181	247	121	-118	95	-100	80	- 83	78	- 79	80	- 80
3/4"	1001	tor	ħŊ	5049	5336	14638	5342	0884	1691	5703	2450	5736	5330		7181	0869	7151	7378	0199	6152	6420	5889	7194	7109	6532	5330	7051	6018	6331	6129	4569	0449
Breadth =	0	Indicator	Reading	017617	5190	1630	5440	4752	4559	2640	5473	5604	5197		7318	6865	7020	7349	6384	2900	6239	5842	2073	7227	0449	5430	1269	6101	6253	6208	4289	6520
Stiffening Ring I		Gage	No.	1	8	m	1	7	9	2	ω	0,	10	ננ	12	13	174	15	16	17	18	19	20	21	22	23	42	25	56	27	82	53
Stiffen	Load	Gage	Factor	1.80	_		>	-						1.82			->	-					1.76			-						

Table IX. Original Data



The cartor   Strain   Indicator   Strain   Indicator   Strain   Indicator   Strain   Indicator   Strain   Indicator   Indica	g Breadth = 3292	11 263	3/4"		5 22080		Decreasing 11060		April 4,	1950
New Color	Indicator	or	Stra	д.	Indicator	Strain	Indicator	Strain	Indicator	From
5158         -101         5050         -108         4940           5479         -135         5338         -141         5189         4630           5290         -126         4682         -128         4630         4630           5200         -120         46882         -128         4750         4630         4630           5010         -129         4691         -130         4558         4770         4650         -128         4750         4650         -128         4750         4750         4650         -128         4750	No. Reading Increment x106		Increm	ent	Reading	Increment x106	Reading	Increment x106	Reading	Original Reading
5479         -135         5338         -141         5189           601         35         5343         53         4630           5290         -55         5343         53         5443           5010         -120         4882         -128         4750           6411         -12         5703         -14         5449           5412         -12         5703         -14         5440           5413         -12         5703         -14         5440           5410         -12         5703         -14         5440           5410         -12         5703         -13         5440           5410         -12         5739         -13         5440           5440         -121         5739         -13         5440           7000         -121         5730         -12         5440           7400         -32         6608         -12         5894           6400         -170         64424         -176         6440           6400         -170         6424         -176         6440           6400         -170         6424         -176         6440	5259		- 62	0)	5158	-101	5050	-108	0464	00
4601         35         4640         39         4630           5290         -120         4882         -128         4750           6010         -120         4882         -128         4750           4821         -129         4691         -130         4758           5717         -12         5703         -14         5640           5717         -12         5703         -14         5640           5717         -12         5703         -14         5640           5717         -12         5703         -14         5640           5872         -128         5739         -13         5601           7090         -121         5739         -13         5601           7090         -121         5730         -12         5730           7090         -121         7148         -129         5601           7090         -120         6408         -219         6863           6410         -23         6608         -219         6849           6410         -25         6608         -219         6849           6410         -25         6608         -219         6849 <td>5614</td> <td></td> <td>6</td> <td>н</td> <td>5479</td> <td>-135</td> <td>5338</td> <td>-141</td> <td>5189</td> <td></td>	5614		6	н	5479	-135	5338	-141	5189	
5290         55         5343         53         5443         53         5443         5010         4882         -128         4750         4882         -128         4750<	19954		-	33	1094	35	0494	39	4630	00
\$010				56	5290	55	5343	53	5443	03
4821         -129         4691         -130         4558           5717         -12         5703         -14         5640           5717         -12         5739         -13         5601           5872         -128         5739         -133         5601           5872         -128         5739         -133         5601           7096         -121         5739         -130         5193           7097         -121         6978         -130         5193           7090         -12         6978         -130         5193           7277         -131         7148         -129         7019           7400         -32         6608         -219         6863           6410         -250         6608         -219         6883           6410         -250         6608         -219         6894           6410         -250         6424         -176         6240           6600         -170         6424         -176         6440           6632         - 43         5895         - 43         6840           6630         - 120         6440         - 80         6540<	5130	0	0	75	5010	-120	7887	-128	4750	- 02
5717         -12         5703         -14         5640           5419         9         5477         5419         9         5477           5872         -128         5739         -133         5601         -           5460         -121         5330         -133         5601         -           7098         84         7181         83         7322         -           7090         -121         6978         -129         7019         -           7090         -121         7148         -129         7019         -           7090         -121         7148         -129         7019         -           7000         -223         6608         -229         6863         -           6410         -223         6608         -219         6394         -           6410         -223         6608         -219         6344         -           6410         -170         64424         -176         6240         -           6536         -34         5895         -43         5894         -           7140         -70         7060         -80         6540         -	- 4950	1	1	83	4821	-129	1691	-130	4558	- 01
5h10         10         5419         9         5477           5872         -128         5739         -133         5601           5460         -121         5330         -130         5193           7098         84         7181         83         7322           7090         -112         6978         -129         6863           7277         -131         7148         -129         7019           7400         -32         7372         -28         7350           6827         -213         6608         -129         7019           6410         -250         6151         -259         5894           6410         -250         6151         -259         5894           6400         -170         6424         -176         6240           6400         -170         6424         -176         6240           650         -120         6424         -176         6240           663         -120         6424         -176         6440           663         -120         6541         -91         6440           663         -86         6541         -91         6440 <td>_</td> <td>_</td> <td></td> <td>н</td> <td>5717</td> <td>- 12</td> <td>5703</td> <td>- 14</td> <td>2640</td> <td>00</td>	_	_		н	5717	- 12	5703	- 14	2640	00
5872         -128         5739         -133         5601         -121         5330         -130         5193         -130         5193         -130         5193         -130         5193         -130         5193         -130         5193         -130         5193         -132         5601         -130         5193         -132         5601         -122         5193         -132         5601         -122         5193         -122         5193         -122         5193         -122         5193         -122         5193         -122         5193         -122         5193         -122         5193         -122         5193         -122         5193         -122         5193         -122         5193         -122         5193         -122         5193         -122         5193         -122         5193         -122         5194         -122         5194         -122         5194         -123         6194         -123         6194         -123         6194         -124         6240         -124         6240         -124         6240         -124         6240         -124         6240         -124         6240         -124         6240         -124         6240         -124 <td< td=""><td>2400</td><td></td><td>1</td><td><u>ω</u></td><td>5410</td><td>10</td><td>5419</td><td>0</td><td>5477</td><td>170</td></td<>	2400		1	<u>ω</u>	5410	10	5419	0	5477	170
5460         -121         5330         -130         5193           7098         84         7181         83         7322           7090         -112         6978         -112         6863           7277         -131         7148         -129         7019           7277         -131         7148         -129         7019           7400         -32         7372         -28         7350           6410         -213         6608         -219         6381           6410         -256         6151         -259         5894           6410         -256         6151         -259         5894           6410         -37         5895         -49         5849           7314         -110         7200         -114         7072           6990         120         7110         120         5434           6990         120         7110         120         5434           7140         - 70         7060         89         6570           6415         - 66         6342         - 73         66258           6415         - 64         6963         - 74         6875	1		1	5	5872	-128	5739	-133	5601	
7098 84 7181 83 7322 7090 -112 6978 -112 6863 7277 -131 7148 -129 7019 7400 -32 7372 -28 7350 6827 -213 6608 -219 6381 6410 -250 6151 -259 5894 6600 -170 6424 -176 6240 5938 - 37 5895 - 43 5843 7314 -110 7200 -114 7072 6632 - 86 6541 - 91 6440 5230 99 5330 100 5434 7140 - 70 7060 - 80 6970 6635 - 66 6342 - 73 6258 6050 - 64 6875 6360 - 70 6441 81 6522	5581 -	ı	ω̈́ ι —	0	2460	-121	5330	-130	5193	t <sub>0</sub> -
7096 84 7181 83 7322 7099 7277 -131 7148 -129 7019 7090 7277 -131 7148 -129 7019 -129 7019 -129 7019 -129 7019 -129 7019 -120 6608 -219 6581 -259 6581 -259 6580 -170 6424 -176 6240 6590 120 7140 7200 -114 7072 - 86 6532 - 86 6541 - 91 6440 6970 - 80 6520 85 6103 6050 79 6050 85 6103 6258 6050 80 6441 81 6522			1		(		1	(		Č
7277 -131 7148 -129 7019 -213 6608 -219 6381 -250 6410 -250 6151 -259 5894 -170 6424 -176 6240 5938 -37 5895 -43 5843 -37 5895 -43 5844 7072 -37 5895 -114 7072 -30 6440 5230 -30 6441 -310 5230 -310 5434 -310 5230 -30 6441 6875 6360 -30 6441 81 6522	12 / \(\frac{1}{2}\)		ンン コンプ		7090	\$ C[	7181	ש ר בי	7322	
7400 - 32 7372 - 28 7350	2/108	8	- 87		7277	-131	7148	-129	7019	- 01
6827         -213         6608         -219         6381         -           6410         -250         6151         -259         5894         -           6400         -170         6424         -176         6240         -           5938         - 37         5895         - 49         5843         -           7314         -110         7200         -114         7072         -           6990         120         7110         120         7230           6632         - 86         6541         - 91         6440         6440           5230         99         5330         100         5434         -           7140         - 70         7060         - 80         6970         -           5230         99         5330         100         5434         -           7140         - 70         7060         - 80         6970         -           6415         - 66         6342         - 73         6258         6103           6050         - 64         6963         - 74         6875         -           7037         - 64         6963         - 74         6522	7432		- 25		2400	- 32	7372	- 28	7350	<b>1</b> 0
6410       -250       6151       -259       5894       -         6600       -170       6424       -176       6240         5938       -37       5895       -43       5843         7314       -110       7200       -114       7072         6990       120       7110       120       7230         6632       - 86       6541       - 91       6440         5230       99       5330       100       5434         7140       - 70       7060       - 80       6970         5230       83       6020       85       6103         6415       - 64       6963       - 74       6875         6360       - 80       6441       81       6522	7040		-145		6827	-213	8099	-219	6381	- 03
6600       -170       6424       -176       6240         5938       - 37       5895       - 43       5843         7314       -110       7200       -114       7072         6990       120       7110       120       7230         6632       - 86       6541       - 91       6440         5230       99       5330       100       5434         7140       - 70       7060       - 80       6970         7140       - 70       7060       - 80       6970         6415       - 66       6342       - 73       6258         6050       79       6130       80       6210         7037       - 64       6963       - 74       6875         6360       80       6441       6522	0999	_	-16	<b>ω</b>	0149	-250	6151	-259	5894	90 -
5938       - 37       5895       - 43       5843         7314       -110       7200       -114       7072         6990       120       7110       120       7230         6632       - 86       6541       - 91       6440         5230       99       5330       100       5434         7140       - 70       7060       - 80       6970         7140       - 70       7060       - 80       6970         6415       - 66       6342       - 73       6258         6050       79       6130       80       6210         7037       - 64       6963       - 74       6875         6360       80       6441       6522	0229		-11(	0	0099	-170	4249	-176	6240	01
7314 -110 7200 -114 7072 - 6990 120 7110 120 7230 6632 - 86 6541 - 91 6440 5230 99 5330 100 5434 7140 - 70 7060 - 80 6970 - 5935 83 6020 85 6103 6415 - 66 6342 - 73 6258 6050 7037 - 64 6963 - 74 6875 6360 80 6441	-   5975   -	1	- 2	10	5938	- 37	5895	- 43	5843	01
6990       120       7110       120       7230         6632       - 86       6541       - 91       6440         5230       99       5330       100       5434         7140       - 70       7060       - 80       6970       -         5935       83       6020       85       6103       -         6415       - 66       6342       - 73       6258         6050       79       6130       80       6210         7037       - 64       6963       - 74       6875         6360       80       6441       6522	- 7424	8	9	0	7314	-110	7200	-114	7072	
6632       - 86       6541       - 91       6440         5230       99       5330       100       5434         7140       - 70       7060       - 80       6970       -         5935       83       6020       85       6103       -         6415       - 66       6342       - 73       6258         6050       79       6130       80       6210         7037       - 64       6963       - 74       6875         6360       80       6441       81       6522	0289		~	N	0669	120	7110	120	7230	03
5230     99     5330     100     5434       7140     - 70     7060     - 80     6970     -       5935     83     6020     85     6103     -       6415     - 66     6342     - 73     6258       6050     79     6130     80     6210       7037     - 64     6963     - 74     6875       6360     80     6441     81     6522	- 6718 -	1	1 5	2	6632	98 -	6541	- 91	0449	8
7140 - 70 7060 - 80 6970 - 80 5935 83 6020 85 6103 6103 6050 79 6130 80 6210 6363 - 74 6875 6360 80 6441 81 6522	23 5131 6		9	<u>س</u>	5230	66	5330	100	5434	<del>1</del> 0
5935       83       6020       85       6103         6415       - 66       6342       - 73       6258         6050       79       6130       80       6210         7037       - 64       6963       - 74       6875         6360       80       6441       81       6522	7210 -	1	1 -	ထ	2140	- 70	2060	- 80	0269	
6415       - 66       6342       - 73       6258         6050       79       6130       80       6210         7037       - 64       6963       - 74       6875         6360       80       6441       81       6522	5852		7	<b>Δ</b>	5935	83	6020	85	6103	05
6050         79         6130         80         6210           7037         - 64         6963         - 74         6875           6360         80         6441         81         6522	-   6481   -	1	7	<u>_</u>	6415	99 -	6342	- 73	6258	05
7037         64         6963         74         6875           6360         80         6441         81         6522	5971			20	6050	26	6130	80	6210	05
6360 80 6441 81 6522	7101			竹	7037	<del>179</del> -	6969	46 -	6875	01
	29 6280	6280		50	6360	80	6441	81	6522	02

Table IX. Original Data



									_																							
1950	000	Strain	Increment x106	103	97	2	- 17	96	85	<b>ω</b>	- 20	89	73		- 26	- 18	2	ر س	- 11	78	96	105	228	-233	230	-240	240	-238	240	-241	238	12-14-1
April 4,	43980	Indicator	Reading		5584	4621	5383	5138	4895	5604	5390	5870	5480		7212	0629	7020	7334	6359	5989	6630	6247	8001	6287	7390	094747	7962	5140	7238	5232	2848	5536
5.0	02	Strain	Increment x106	106	66	2	- 10	95	82	- 10	- 20	99	2		- 22	- 14	-1	-	-	25	46	100	231	-234	231	-245	242	-240	238	-244	237	-242
Increasing	32920	Indicator	Reading	5257	5487	4623	2400	5042	4810	5612	2410	5802	2402		7238	8089	7018	7337	6340	5961	6534	6142	7773	6520	2160	00247	7722	5378	8669	5473	2610	5780
Load	00	Strain	Increment x106	103	98	7	- 10	66	83	- 12	- 12	69	77		- 17	- 13	Н	m	0	56	96	103	232	-236	232	-242	544	-239	247	-242	239	-243
Bending	21900		Reading		5388	4625	5410	2464	4728	5622	5430	5736	5337		7260	6822	7019	7338	6351	5936	0449	2409	7542	6754	6929	7645	2480	5618	0929	5717	7373	6027
Pure	2	Strain	Increment x106	108	102	8	- 18	98	87	0	- 28	89	75		- 33	- 17	N	i	- 10	58	26	101	233	-236	237	-246	544	-242	242	-243	236	-248
	1007	or	• 0	5048	5290	4630	5420	8484	4645	5634	2445	5668	5266		7277	6835	7018	7335	6360	5910	£69	5939	7310	0669	2699	5184	7236	5857	6519	5959	7134	6270
adth =	0	Indicator	Reading	0464	5188	14628	5438	4750	4558	5634	5470	2600	5191		7310	6852	7013	7336	6370	5882	2479	5838	7077	7226	0949	5430	6992	6609	6277	6202	8689	6518
Ring		Gage	No.	1	N	m	4	2	9	2	00	6	10		12	LJ.	14	15	16	17	18	19	8	21	22	23	77	25	56	27	82	59
Stiffening	Load	Gage	Factor	1.80	_		*							1,82	_		-,						1.76			>						

Table IX. Original Data

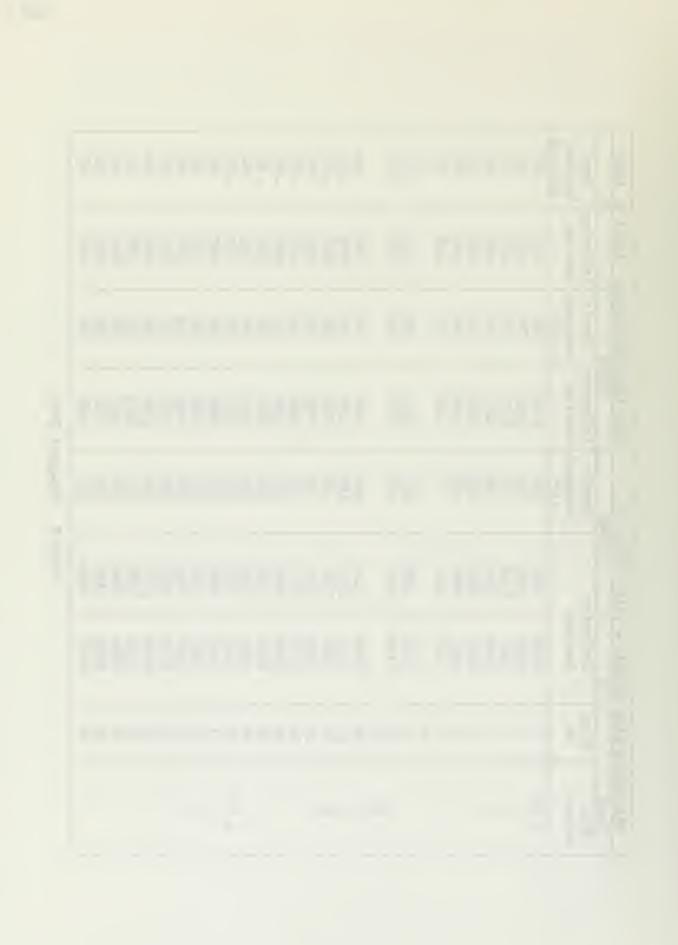


																														_		
1950		From	Original Reading	8	_ OJ_	8	8	8	- 02	8	8	05	_ 01		8	7.0	- 01	01	8	- 01	89	- 03	20 -	90	90 -	05	- 05	90	- 05	80	- 08	0,5
April 4,		Indicator	Reading	0464	5187	14628	5438	4750	4556	5637	5470	5602	5190		7310	6857	7012	7337	6370	5881	6315	5835	2070	7232	4549	5435	6987	6105	6272	6210	6890	6523
	0	Strain	Increment x106	-102	- 92	9	ω	- 93	- 79	11	13	- 65	69 -	,	18	13	8	m	0	- 27	- 87	-100	-212	210	-214	216	-223	212	-221	212	-220	212
Decreasing	11060	Indicator	Reading	5056	5298	4628	5420	4859	4650	5631	5443	5678	5271		7274	0489	7017	7333	6360	5916	6375	5952	7318	0669	6705	5186	7248	5858	6531	5960	7145	6270
Load	0	Strain	Increment x106	-116	-110	23	12	-108	- 93	12	18	- 77	- 79		21	17	0	0	11	- 29	- 99	-114	-260	265	-259	271	-272	270	-268	273	-265	275
	20600	Indicator	Reading	5158	5390	14622	5412	4952	4729	5620	5430	5743	5340		7256	6827	7018	7330	6351	5943	2949	6052	7530	6780	6169	02647	7471	5646	6752	5743	7365	6053
Pure Bending		Strain	Increment x106	98 -	- 8th	1	17	- 78	- 73	4	22	- 50	- 61		23	20	2	7 -	11	- 17	69 -	- 81	-211	228	-212	239	-219	236	-218	238	-218	242
Breadth = 3/4"	32960	Indicator	Reading	5274	5500	4620	2400	2060	4822	5608	5412	5820	5419	3	7235	6810	7018	7330	0469	5972	6561	9919	0622	6515	7178	6694	7743	5376	7020	5470	7630	5778
Stiffening Ring B		Gage	No.	Н	2	m	7	ν,	9	2	ω	0,	10	11	12	13	14	15	16	17	18	19	20	21	22	23	72	25	92	27	28	29
Stiffen	Load	Gage	Factor	1.80	×	>								1,82									1.76	_	>	•						

Table IX. Original Data

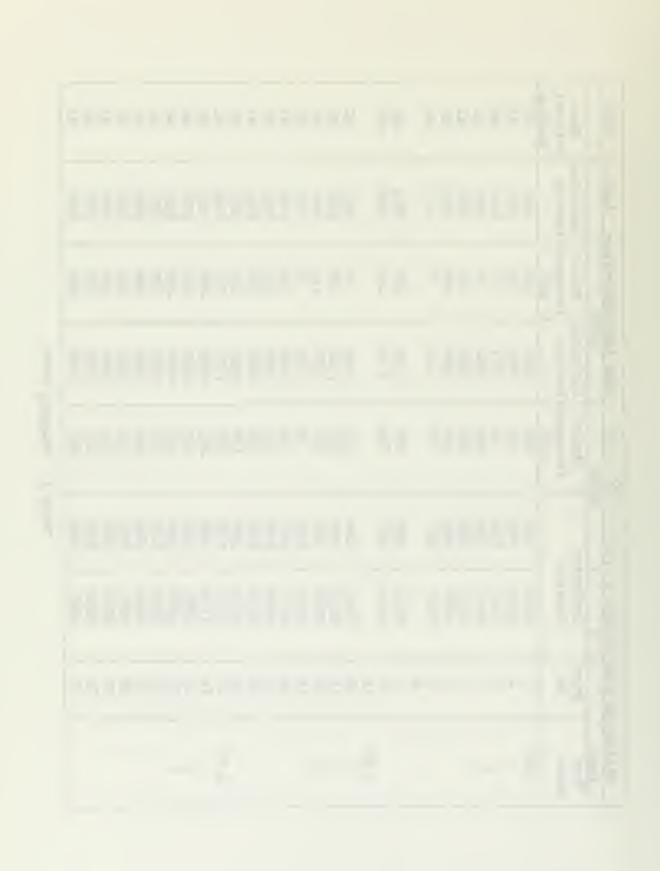
Total	Stiffening Rin	ng Ring	Breadth = 7	2/16" 5/8 =	2° :	Load Incr-	Incr-Decreasing	April	5, 1950
Mo.   Reading   Increment   Strain   Indicator   Increment   Reading   Increment   Increment   Increment   Increment   Increment   Increment   Reading   Increment   Incre	Load		0	1.90	040	3798	30		0
No.         Reading         Increment Reading         Indept Size         2577         2476         4950         2562         4469         2577         276         4609	ල්පළිල	Gage	Indica	tor	Strain	Indicator	Strain	Indicator	From
.80 1 4952 5209 257 5456 247 4950 25162 247 4950 25162 247 4450 247 5456 247 5456 247 44950 25162 247 44950 247 5456 247 44950 247 5456 247 44950 247 5456 247 6496 2496 2496 2496 2496 2496 2496 2496	Factor	No.	Readin	80	Increment x106		Increment x106	Reading	Original Reading
2         5166         5499         273         5715         276         5162           4         4440         5035         -49         4450         -59         4609           5         4740         5035         -74         5272         -79         5438           5         4761         4847         296         5143         226         4469           6         4551         4847         296         5143         226         4469           7         5622         5628         6         5618         -10         5622           8         5618         2881         263         5131         226         5143           9         5618         2881         263         5131         250         5188           10         5190         5453         263         5723         270         5188           11         7280         7174         -106         7088         -86         5618           12         6450         6996         146         7088         -86         5618           13         6850         6996         146         7735         128         6450           14 </th <th>1,80</th> <th>7</th> <th>4952</th> <th>5209</th> <th>257</th> <th>5456</th> <th>247</th> <th>0564</th> <th>- 02</th>	1,80	7	4952	5209	257	5456	247	0564	- 02
3         4611         4562         - 49         4503         - 59         4609           4         5440         5351         - 89         5272         - 79         4458           5         4761         5351         - 89         5272         - 79         4478           6         4451         4847         296         5143         296         4478           7         5622         5628         6         5618         - 10         5622           9         5628         6         5618         - 10         5622         - 79         4478           10         5622         5628         6         5618         264         4478           11         7280         7174         - 106         7088         - 86         7280           11         7280         7174         - 106         7088         - 86         7280           11         7280         7174         - 106         7088         - 86         7280           12         6850         6996         146         7136         7353         7353           16         6450         6712         130         7258         128         6450 <th></th> <th>7</th> <th>5166</th> <th>5439</th> <th>273</th> <th>5715</th> <th>276</th> <th>5162</th> <th><del>10 -</del></th>		7	5166	5439	273	5715	276	5162	<del>10 -</del>
4         54440         5351         -89         5272         -79         5438           5         4761         5035         274         5299         264         4758         4758           6         4551         4847         296         5143         296         4547         -79         5438         -70         4758         -79         4758         -79         4758         -70         4759         -70         4759         -70         4758         -70         4759         -70         4750         -70         4750         -70         4750         -70         4750         -70         4750         -70         4750         -70         4750         -70		<u></u>	4611	4562	647 -	4503	- 59	6094	- 02
5         4761         5035         274         5299         264         4758           6         4551         4847         296         5143         296         4547           7         5622         5628         6         5143         296         4547           9         5618         263         6131         296         4547           10         5190         5453         263         6131         250         5615           11         7280         7174         -106         7088         -86         7280           12         7280         7174         -106         7088         -86         7280           13         6850         6996         130         7258         128         6849           14         730         7146         7135         128         6849         -864           15         6850         6996         136         6998         189         6998         189         6489           16         6430         7721         180         6698         316         6498         7167           20         7060         7742         345         7080         335         <	-	4	5440	5351	- 89	5272	- 79	5438	- 02
6         44551         4847         296         5143         296         4547           7         5622         5628         6         5618         -10         5622           8         5618         5881         263         6131         250         5615           10         5190         5453         263         5723         270         5188           11         7280         7174         -106         7088         -86         7280           13         6850         6996         146         7135         139         6849           14         7000         7130         130         7258         128         6998           14         7000         7130         130         7258         128         6998           15         6850         6996         1446         7135         139         6849           16         6430         6713         183         6998         186         6998           16         6430         6713         183         6698         185         6427           18         6152         371         6883         360         6150           19 <td< th=""><th>•</th><th>ν,</th><th>4761</th><th>5035</th><th>274</th><th>5299</th><th>564</th><th>4758</th><th>- 03</th></td<>	•	ν,	4761	5035	274	5299	564	4758	- 03
7         5622         5628         6         5618         -10         5622           8         5618         5831         263         6131         250         5615         -           10         5190         5453         263         6131         250         5615         -           11         7280         7174         -106         7088         - 86         7280         5188         -           12         7280         7174         -106         7088         - 86         6849         - 8449         - 86         6849         6849         - 128         6789         - 128         6789         - 128         6789         - 128         6789         - 128         6789         - 128         6789         - 128         6789         - 128         6789         - 128         6427         - 128         6427         - 128         6427         - 128         6428         189         6427         - 128         6428         189         6428         189         6427         - 128         6428         189         6428         189         6427         - 128         6428         189         6428         189         6428         189         6408         189		9	4551	2484	596	5143	296	4542	<del>+</del> 00 -
9         5618         5881         263         6131         250         5615           10         5190         5453         263         5723         270         5188           11         7280         7174         -106         7088         -86         7280           13         6850         6996         146         7135         139         6849           13         6850         6996         146         7135         139         6849           14         7000         7130         130         7258         128         6998           15         6430         6713         183         6998         185         6487           16         6430         6713         183         6998         185         6487           16         6430         6713         183         6998         185         6487           16         6430         6713         183         6698         316         6487           18         6152         315         6698         316         6483         360         6450           20         7060         7440         380         760         735         5384 </th <th></th> <th>~ «</th> <th>5622</th> <th>5628</th> <th>9</th> <th>5618</th> <th>- 10</th> <th>5622</th> <th>00</th>		~ «	5622	5628	9	5618	- 10	5622	00
10         5190         5453         263         5723         270         5188           11         7280         7174         -106         7088         - 86         7280           13         6850         6996         146         7135         139         6849           14         7000         7130         130         7258         128         6998           15         6830         6713         183         6698         185         6849           15         6843         6713         183         6698         185         6898           16         6430         6713         183         6698         185         6427           16         6430         6713         183         6698         185         6898           16         6430         6713         183         6698         316         6427           18         6522         371         688         326         6150         5863           19         5853         603         380         7607         335         6384           20         7060         77440         380         7607         335         6384		00	5618	5881	263	6131	250	5615	- 03
12         7280         7174         -106         7088         - 86         7280           13         6850         6996         146         7135         139         6849           14         7000         7130         130         7258         128         6998           15         7357         7381         24         7409         28         7353           16         6430         6713         183         6698         316         6998           16         6430         6713         183         6698         316         6427           16         6430         6713         183         6698         316         6427           17         5867         6282         371         6883         360         6150           18         6152         6523         371         6883         360         6150           20         7060         7440         380         7812         372         7057           21         7162         6785         -377         6408         -355         6394           22         6397         5018         -362         4608         -355         6260	1 82	01 -	5190	5453	263	5,723	0/2	5188	
13         6850         6996         146         7135         139         6849           14         7000         7130         130         7258         128         6998           15         7357         7381         24         7409         28         7353           16         6430         6713         183         6998         185         6427           17         5867         6282         315         6698         316         6427           18         6430         6713         183         6998         185         6427           17         5867         6282         315         6698         316         6427           18         6152         6523         371         6883         360         6150           20         7060         7440         380         7812         372         7057           21         7162         6785         -377         6408         336         6394           22         6397         6742         345         7607         335         6394           24         6690         5723         -337         539         639           25 <t< th=""><td>→ -</td><td>12</td><td>7280</td><td>7174</td><td>-106</td><td>7088</td><td></td><td>7280</td><td>00</td></t<>	→ -	12	7280	7174	-106	7088		7280	00
14     7000     7130     130     7258     128     6998       15     7357     7381     24     7409     28     7353       16     6430     6713     183     6998     185     6427       17     5867     6282     315     6698     316     6427       18     6152     6523     371     6883     360     6150       19     5853     6033     180     6211     178     5851       20     7060     7440     380     7812     372     7057       21     7162     6785     -377     6408     -377     7167       22     6397     6742     -362     4663     -377     7167       23     5380     7607     338     6397       24     6934     7272     338     7607     335     6394       25     6060     5723     -337     5392     -355     5384       26     6259     331     6915     325     6260       28     6871     7198     327     7521     323     6870       29     6497     -337     5828     -332     6500       29     6497     -337<		13	6850	9669	346	7135	139	6489	
15       7357       7381       24       7409       28       7353         16       6430       6713       183       6998       185       6427         17       5867       6282       315       6698       316       5863         18       6152       6282       315       6698       316       5863         18       6152       6283       371       6883       360       6150         19       5853       6033       180       6211       178       5851         20       7060       7440       380       7812       372       7057         21       7162       6785       -377       6408       -377       7167         22       6397       6742       346       -362       4663       -355       5384         24       6934       7272       338       7607       335       6937         25       6060       5723       -337       5325       6260         28       6871       7198       327       7521       323       6500         29       6497       6160       -337       5828       -332       6500	-	14	2000	7130	130	7258	128	8669	- 02
16       6430       6713       183       6998       185       6427         17       5867       6282       315       6698       316       5863		15	7357	7381	77	2409	28	7353	70 -
17       5867       6282       315       6698       316       5863       -         18       6152       6523       371       6883       360       6150       -         19       5853       6033       180       6211       178       5851       -         20       7060       7440       380       7812       372       7057         21       7162       6785       -377       6408       -377       7057         22       6397       6742       345       7080       338       6397         23       5380       5018       -362       4663       -355       5384         24       6934       7272       338       7607       335       6933         25       6060       5723       -337       5392       -315       6064         26       6259       6590       331       6915       325       6200         28       6871       7198       327       7521       323       6500         29       6497       6160       -337       5828       -332       6500         29       6497       6160       -337       5828 <t< th=""><td></td><td>16</td><td>6430</td><td>6713</td><td>183</td><td>8669</td><td>185</td><td>6427</td><td>- 03</td></t<>		16	6430	6713	183	8669	185	6427	- 03
18       6152       6523       371       6883       360       6150         19       5853       6033       180       6211       178       5851         20       7060       7440       380       7812       372       7057         21       7162       6785       -377       6408       -377       7057         22       6397       6742       -377       6408       -377       7167         23       5380       5018       -362       4663       -355       5384         24       6934       7272       338       7607       335       6933         24       6934       7272       338       7607       335       6933         25       6060       5723       -337       5392       -335       6260         26       6259       5590       331       6915       325       6200         28       6871       7198       327       7521       323       6500         29       6497       6160       -337       5828       -332       6500         29       6497       -337       5828       -322       6500		17	2867	6282	315	8699	316	5863	70 -
19     5853     6033     180     6211     178     5851       20     7060     7440     380     7812     372     7057       21     7162     6785     -377     6408     -377     7167       22     6397     6785     -377     6408     -377     7167       22     6397     6785     -377     6408     -377     7167       23     5380     5018     -362     4663     -355     5384       24     6934     7272     338     7607     335     6933       25     6060     5723     -337     5392     -331     6064       26     6259     6590     331     6915     325     6260       27     6194     5864     -330     5537     -327     6200       28     6871     7198     327     5828     -332     6500       29     6497     6160     -337     5828     -332     6500		1.8	6152	6523	371	6883	360	6150	
20       7060       74440       380       7812       372       7057         21       7162       6785       -377       6408       -377       7167         22       6397       6742       345       7080       338       6397         23       5380       5018       -362       4663       -355       5384         24       6934       7272       338       7607       335       6933         25       6060       5723       -337       5392       -331       6064         26       6259       6590       331       6915       325       6200         28       6871       7198       327       7521       323       6870         29       6497       6160       -337       5828       -332       6500	ì	13	5853	6033	180	6211	178	5851	20 -
7162 6785 -377 6408 -377 7167 6408 6397 6542 345 7080 338 6397 6542 6538 6397 6538 6539 6539 6539 6539 6539 6539 6539 6539	1.76	20	2060	2440	380	7812	372	7057	00
6397     6742     345     7080     338     6397       5380     5018     -362     4663     -355     5384       6934     7272     338     7607     335     6933       6060     5723     -337     5392     -331     6064       6259     531     6915     325     6260       6194     5864     -330     5537     -327     6200       6871     7198     327     7521     323     6870       6497     6160     -337     5828     -332     6500		27	7162	6785	-377	8049	-377	7167	05
5380     5018     -362     4663     -355     5384       6934     7272     338     7607     335     6933     -       6060     5723     -337     5392     -331     6064       6259     531     6915     325     6260       6194     5864     -330     5537     -327     6200       6871     7198     327     7521     323     6870       6497     6160     -337     5828     -332     6500		22	6397	2429	345	2080	338	6397	2
6934 7272 338 7607 335 6933 - 6060 5723 - 337 5392 - 331 6064 6259 6259 633 6590 331 6915 325 6260 6194 5864 - 330 5537 - 327 6200 6871 7198 327 7521 323 6870 - 6497 6160 - 337 5828 - 332 6500	-	23	5380	5018	-362	4663	-355	5384	004
6060 5723 -337 5392 -331 6064 6259 6590 331 6915 325 6260 6194 5864 -330 5537 -327 6200 6871 7198 327 7521 323 6870 -		77	4669	7272	338	7607	335	6933	
6259 6590 331 6915 325 6260 6194 5864 -330 5537 -327 6200 6871 7198 327 7521 323 6870 - 6497 6160 -337 5828 -332 6500		25	0909	5723	-337	5392	-331	ty909	†o
6194         5864         -330         5537         -327         6200           6871         7198         327         7521         323         6870         -           6497         6160         -337         5828         -332         6500		56	6259	6590	331	6915	325	6260	OI OI
6871 7198 327 7521 323 6870 - 6497 6160 -337 5828 -332 6500		27	6194	1985	-330	5537	-327	6200	90
6497   6160   -337   5828   -332   6500		88	6871	7198	327	7521	323	6870	
		53	2649	0919	-337	5828	-332	6500	င္ပ

Table X. Original Data



,																															
7, 1950	0	From	Original Reading	CO	- 03	00	05	10 -	70 -	00	- 05	030	,	05	- 01	8	- 02	- 01	- 01	- 01	07	- 01	07	8	05	10	05	8	క్ర	85	95
April		Indicator	Reading	4950	5160	1610	5437	4758	4545	5623	5613	5288		7277	64789	2000	7354	0649	5869	6151	5853	7055	7171	6395	5390	6933	0209	6260	6205	6872	6508
Incr-Decreasing	35	Strain	Increment x106	188	223	- 59	22	215	258	0	224	250		- 90	170	151	3	338	450	320	107	236	-240	201	-208	187	-186	178	-180	177	-185
Load Incr-	36885	Indicator	Reading	5370	5645	4501	5252	5240	5109	5651	4119	5730		7050	7220	7332	2430	7168	0489	0989	6087	7575	6499	6831	4364	7337	2660	8499	5810	7258	6100
ó = ,35	10	Strain	Increment x106	232	259	- 50	106	566	302	28	272	289		-135	200	181	34	399	520	390	128	283	-281	235	-256	218	-222	210	-212	211	-218
2/16" %	20110	or	50	51.82	5422	4560	5329	5025	4851	5651	5890	5480		2740	7050	7181	7390	0£89	6390	0459	5980	7339	6889	0699	5132	7150	5846	0249	5990	7081	6285
Breadth = 7	0	Indicator	Reading	4950	5163	0794	5435	4759	6454	5623	5618	5191		7275	6850	2000	7356	6431	5870	6152	5852	2056	7170	6395	5388	6932	8909	6260	6202	6870	6503
Ring		Gage	No.	1	23	m	7	N	9	~ (	ю o	10	11	12	13	14	15	16	17	18	19	8	21	22	23	54	25	56	27	- 58 - 58	62
Stiffening	Load	Gage	Factor	1.80	_		->-						1.82			•	-					1.76	_		>						

Table X. Original Data



Indicator   Strain   Indicator   Strain   Indicator   Strain   Indicator   Strain   Indicator   Increment   Reading   Increment   Reading   Increment   Indicator   Increment   Increment   Indicator   Indicator   Increment   Indicator   Indicato	Stiffening Ring	Breadth =	3, "91/2	2/6 = .5,	Load Incr-	Incr-Decreasing	April	6, 1950
Indicator   Strain   Indicator   Indicator   Indicator   Indicator   Indicator   Indicator   Indicator   Indicat		0	20	360	345	50		
Reading         Increment Reading         Increment Reading         Increment Reading         Reading         Increment Reading         Reading           4949         5163         214         5312         149         4949           5161         5410         249         5590         1494         4949           5131         4543         214         5523        65         5438           4534         4543        14         5253        65         5438           44756         5013         257         5192         1779         4459           44756         5013         257         5192         1779         4454           44756         5013         257         5192         1779         4454           44847         303         5660         3         5620         5188         4548           5618         5489         27         6082         220         5188         4548           5618         5489         301         5709         220         5188         5620           5887         6440         580         6885         145         5486         6430           6430         6560         394	Gag		tor	Strain	Indicator	Strain	Indicator	From
4949         5163         214         5312         149           5161         5410         249         5590         180           5161         5410         249         5590         180           4594         4543         - 51         4490         - 53           5432         5318         - 114         5253         180           4756         5013         257         5192         179           4756         5013         257         5192         179           4756         5603         277         5065         218           5613         5657         39         5660         3           5618         5657         39         5660         3           5618         5657         39         5660         220           5618         7207         -234         7242         -165           6843         7207         -234         7242         -165           6849         7207         -234         7242         -165           6849         7207         -234         7242         -165           6849         6460         580         -165           6856 <th>No</th> <th></th> <th>ρΌ</th> <th>Increment x106</th> <th>Reading</th> <th>Increment x106</th> <th></th> <th>Original Reading</th>	No		ρΌ	Increment x106	Reading	Increment x106		Original Reading
5161         5410         249         5590         180           4594         4543         - 51         4490         - 53           5432         5318         - 114         5253         - 65           4756         5013         257         5192         179           4756         5013         257         5192         179           4756         5013         257         5192         179           4756         5608         277         5065         218           5613         5890         277         6082         220           5188         5489         301         5709         220           7267         7077         -234         7242         -165           6938         7207         209         7352         145           6949         7207         224         7442         -165           6940         7394         46         6833         273           6490         6560         394         6683         418           6490         6560         394         6683         -159           658         656         394         668         -159 <t< td=""><td>H</td><td></td><td>5163</td><td>214</td><td>5312</td><td>149</td><td>617617</td><td>00</td></t<>	H		5163	214	5312	149	617617	00
4594         4543        51         4490        53           5432         5318        114         5253        65           5432         5013         257         5192         179           4756         5013         257         5192         179           4756         5013         257         5065         218           5613         5657         39         5660         218           5613         5657         39         5660         218           5613         5657         39         5660         218           5613         5657         39         5660         220           7267         7077         -140         7055         -72           6843         7077         -234         7242         -165           6948         7394         460         7242         -165           6949         7274         224         7433         175           6490         7274         224         7433         175           6480         6480         7274         224         7433           7163         6560         7274         7242         145      <	2		5410	546	5590	180	5162	01
5432         5318         -114         5253         -65           4756         5013         257         5192         179           4756         4847         303         5665         218           5618         5657         39         5660         3           5618         5657         39         5660         3           5613         5890         277         6082         192           5618         5489         301         5709         220           7267         7277         -234         7242         -165           6998         7207         -234         7242         -165           6998         7207         -234         7242         -165           6998         7207         -234         7242         -165           6998         7207         -234         7242         -165           6490         6460         394         6885         414           6490         6467         580         6885         414           7050         7274         224         7438         -159           658         5209         -181         5080         -129      <	3		4543	- 51	0644	- 53	4599	05
4756         5013         257         5192         179           4544         4847         303         5065         218           5618         5657         39         5660         3           5613         5890         277         6082         218           5613         5890         277         6082         192           5613         5890         277         6082         192           7267         7077         -234         7242         -165           6843         7077         -234         7242         -165           6843         7207         209         7438         444           6998         7207         209         7438         444           6998         7207         209         7438         444           6998         6450         394         6885         448           6430         6460         580         -159         67           7050         7274         224         7433         159           7050         7274         224         7433         159           6387         6560         173         6680         -129	7		5318	-114	5253	- 65	5438	90
4544         4847         303         5065         218           5618         5657         39         5660         3           5613         5890         277         6082         192           5188         5489         277         6082         192           5188         5489         277         6082         192           5188         5489         277         6082         192           6843         7207         -234         7242         -165           6998         7207         -234         7242         -165           6998         7207         40         7242         -165           6998         7207         40         7242         -165           6998         7207         40         7242         -165           6998         7207         40         7438         4418           6430         6467         580         6885         4418           6480         6560         181         7194         6480         -159           6387         6560         179         6680         -129           6387         6560         149         7185         -100<	3		5013	257	5192	179	4757	01
5618         5657         39         5660         3           5613         5890         277         6082         192           5188         5489         301         5709         220           5188         5489         301         5709         220           7267         7077         -234         7242         -165           6843         7207         -234         7242         -165           6998         7207         -234         7242         -165           6998         7207         47         7443         44           6998         7207         47         7443         44           6490         460         7223         333         67           6490         460         7223         333         67           6490         460         7223         333         67           6490         460         7223         333         67           6480         7274         224         7433         159           650         5209         181         224         7433         159           6387         6560         124         7433         159	9		4847	303	5905	218	4545	01
5613         5890         277         6082         192           5188         5489         301         5709         220           7267         7127         -140         7055         -72           6843         7277         -234         7242         -165           6998         7207         -234         7242         -165           6998         7207         -234         7242         -165           6998         7207         -234         7242         -165           6998         7207         -234         7242         -165           6998         7207         40         7438         444           6430         6460         7223         333         418           6430         6467         580         6885         418           6450         7274         224         7433         159           7163         6540         -169         678         -129           658         5209         -181         5080         -129           653         704         6490         -100           620         668         7107         -100           620         70	2		5657	39	2660	m	5620	05
5613         5890         277         6082         192           5188         5489         301         5709         220           7267         727         -140         7055         -72           6843         7207         -234         7242         -165           6998         7207         209         7242         -165           7347         7394         440         7223         145           6430         6890         460         7223         333           6430         6890         460         7223         333           6166         6560         394         6885         418           6166         6560         394         6885         418           6166         6560         394         6885         678           6166         6560         394         6883         273           6166         6560         173         688         120           6387         6560         173         688         104           6281         5300         5209         149         7185         100           6282         6068         5920         -148         5968 <td><math>\infty</math></td> <td></td> <td>,</td> <td></td> <td></td> <td></td> <td></td> <td></td>	$\infty$		,					
7267         7127         -140         7055         -72           6843         7077         -234         7242         -165           6998         7207         209         7352         145           7347         7394         40         7223         145           7347         7394         460         7223         145           7347         7394         460         7223         145           7347         7394         460         7223         145           6430         6460         394         6885         418           6166         6560         394         6885         418           6166         6560         394         6885         67           7050         7274         224         7433         159           7050         7274         224         7433         159           6387         6560         173         6680         -129           6387         6560         149         7185         -100           6251         6391         149         7185         -100           6262         6068         -140         6260         -100 <t< td=""><td>0</td><td></td><td>5890</td><td>277</td><td>6082</td><td>192</td><td>5612</td><td>01</td></t<>	0		5890	277	6082	192	5612	01
7267 7127 -140 7055 -72 6843 7077 -234 7242 -165 6898 7207 209 7252 145 6430 6890 460 7223 333 646 6560 394 6835 418 6166 6560 394 6833 273 5858 5956 98 6023 67 7050 7274 224 7433 159 7050 7274 224 7433 159 7050 7274 224 7433 159 650 173 6680 120 6387 6560 -181 5080 -129 6202 6369 -148 5813 -107 6251 6068 -134 5968 -100 6202 6362 -140 6490 99 6202 6362 -140 6260 -102	10		2489	301	5209	220	5188	00
7267 7127 -140 7055 -72 6843 7077 -234 7242 -165 6998 7207 209 7352 145 6430 6890 460 7223 333 6430 6890 460 7223 333 6466 6560 394 6835 418 6166 6560 394 6833 273 5858 5956 98 6023 67 7050 7274 224 7433 159 7163 6947 -216 6788 -159 6387 6560 173 6680 120 5390 5209 -181 5080 -129 6202 6068 -134 5968 -100 6202 6068 -148 5968 -100 6202 6362 -140 6490 99 6202 6362 -140 6260 -102	11							
6843       7077       -234       7242       -165         6998       7207       209       7352       145         7347       7394       47       7438       44         6430       6890       460       7223       333         6467       580       6885       418         6166       6560       394       6885       418         6166       6560       394       6885       418         7050       7274       224       7433       159         7050       7274       224       7433       159         6387       6560       173       6680       120         7163       6947       -216       6788       -129         7163       6947       -216       6788       -129         6068       5920       -181       5080       -129         6068       5920       -149       6490       99         6202       6068       -134       5968       -100         6868       7010       142       7107       97         6502       6362       -140       6260       -102         6502       6360       <	12		7127	-140	7055	- 72	7271	70
6998         7207         209         7352         145           7347         7394         47         7438         44           6430         6890         460         7223         333           5887         6467         580         6885         418           6166         6560         394         6885         418           6166         6560         394         6885         418           6166         6560         394         6833         273           6166         6560         394         6833         273           6050         7274         224         7433         159           6947         -216         6788         -159           6387         6560         173         6680         -129           6397         149         7185         100           6202         6068         -149         5968         -100           6202         6068         -140         6260         -100           6502         6362         -140         6260         -102           6502         6362         -140         6260         -102	13		2027	-234	7242	-165	6845	05
7347 7394 47 7438 44 6430 6890 460 7223 333 5887 6467 580 6885 418 6166 6560 394 6833 273 5858 5956 98 6023 67 7050 7274 224 7433 159 7163 6947 -216 6788 -159 6387 6560 173 6680 120 5390 5209 -181 5080 -129 6068 5920 -184 5813 -107 6202 6068 -134 5968 -100 6868 7010 140 6490 99 6202 6068 -134 5968 -100	14		7207	209	7352	145	6669	To
6430         6890         460         7223         333           5887         6467         580         6885         418           6166         6560         394         6833         273           6166         6560         394         6833         273           5858         5956         98         6023         67           7050         7274         224         7433         159           7163         6947         -216         6788         -159           6387         6560         173         6680         120           6397         1449         7185         104           6068         5920         -148         5981         -107           6251         6391         1440         6490         99           6262         6068         -134         5968         -100           6868         7010         142         7107         97           6502         6362         -140         6260         -102	15		7394	47	2438	主	7349	05
5887         6467         580         6885         418           6166         6560         394         6833         273           6166         6560         394         6833         273           5858         5956         98         6023         67           7050         7274         224         7433         159           7163         6947         -216         6788         -159           6387         6560         173         6680         120           6387         6560         -181         5080         -129           6932         7081         149         7185         104           6068         5920         -148         5813         -107           6251         6391         140         6490         99           6202         6068         -134         5968         -100           6868         7010         142         7107         97           6502         6362         -140         6260         -102	16		0689	1460	7223	333	6430	00
6166         6560         394         6833         273           5858         5956         98         6023         67           7050         7274         224         7433         159           7163         6947         -216         6788         -159           6387         6560         173         6680         120           5390         5209         -181         5080         -129           6932         7081         149         7185         104           6068         5920         -148         5813         -107           6251         6391         140         6490         99           6202         6068         -134         5968         -100           6868         7010         142         7107         97           6502         6362         -140         6260         -102	17		2949	580	6885	418	5885	- 02
5858         5956         98         6023         67           7050         7274         224         7433         159           7163         6947         -216         6788         -159           6387         6560         173         6680         120           5390         5209         -181         5080         -129           6932         7081         149         7185         104           6068         5920         -148         5813         -107           6251         6391         140         6490         99           6202         6068         -134         5968         -100           6868         7010         142         7107         97           6502         6362         -140         6260         -102	18		6560	364	6833	273	9919	00
7050         7274         224         7433         159           7163         6947         -216         6788         -159           6387         6560         173         6680         120           5390         5209         -181         5080         -129           6932         7081         149         7185         104           6068         5920         -148         5813         -107           6251         6391         140         6490         99           6202         6068         -134         5968         -100           6868         7010         142         7107         97           6502         6362         -140         6260         -102	13		5956	86	6023	29	5860	02
7163         6947         -216         6788         -159           6387         6560         173         6680         120           5390         5209         -181         5080         -129           6932         7081         149         7185         104           6068         5920         -148         5813         -107           6251         6391         140         6490         99           6202         6068         -134         5968         -100           6868         7010         142         7107         97           6502         6362         -140         6260         -102	200		7274	224	7433	159	7052	02
6387         6560         173         6680         120           5390         5209         -181         5080         -129           6932         7081         149         7185         104           6068         5920         -148         5813         -107           6251         6391         140         6490         99           6202         6068         -134         5968         -100           6868         7010         142         7107         97           6502         6362         -140         6260         -102	21		2469	-216	6788	-159	7168	05
5390         5209         -181         5080         -129           6932         7081         149         7185         104           6068         5920         -148         5813         -107           6251         6391         140         6490         99           6202         6068         -134         5968         -100           6868         7010         142         7107         97           6502         6362         -140         6260         -102	22		6560	173	0899	120	6390	03
6932         7081         149         7185         104           6068         5920         -148         5813         -107           6251         6391         140         6490         99           6202         6068         -134         5968         -100           6868         7010         142         7107         97           6502         6362         -140         6260         -102	23		5209	-181	5080	-129	5393	03
6068         5920         -148         5813         -107           6251         6391         140         6490         99           6202         6068         -134         5968         -100           6868         7010         142         7107         97           6502         6362         -140         6260         -102	77		7081	149	7185	104	6935	03
6251         6391         140         6490         99           6202         6068         -134         5968         -100           6868         7010         142         7107         97           6502         6362         -140         6260         -102	25		5920	-148	5813	-107	6072	70
6202         6068         -134         5968         -100           6868         7010         142         7107         97           6502         6362         -140         6260         -102	26		6391	149	0649	66	6256	05
6868         7010         142         7107         97           6502         6362         -140         6260         -102	27		8909	-134	5968	-100	6210	80
6502 6362 -140 6260 -102	28		2010	145	7107	26	0289	05
	29		6362	-140	6260	-102	6508	90

Table X. Original Data

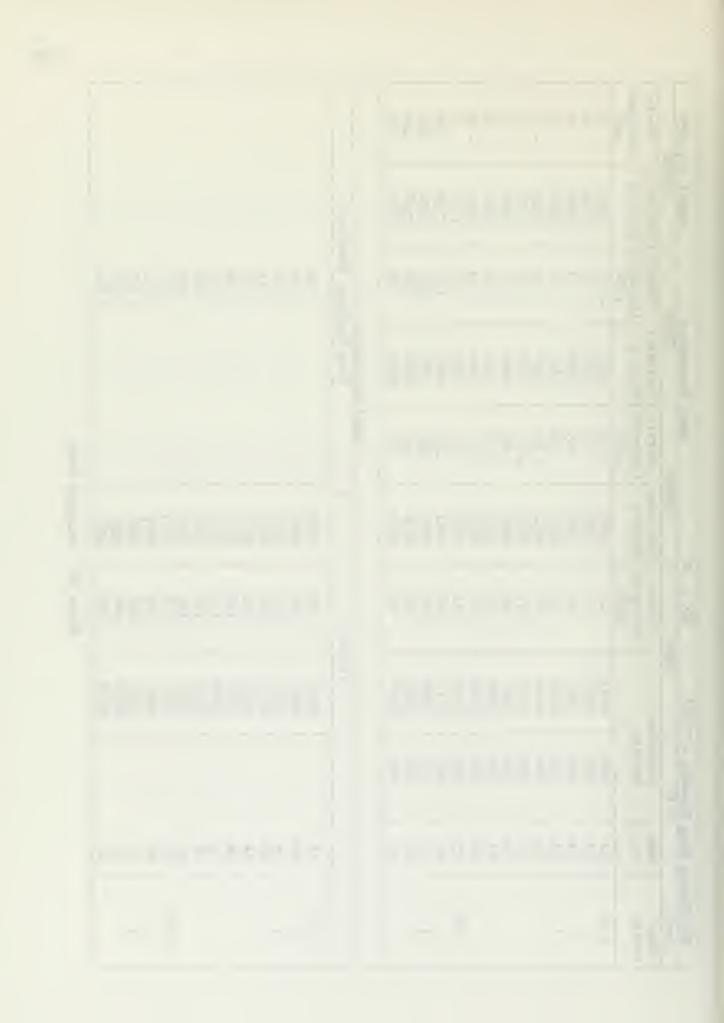
_	1																														
6, 1950	0	From	Original Reading	00	10	03	00	10	_ 01	05	C	05		02	05	03	05	03	- 01	8	- 02	- 02	63	- 02	05	00	05	00	も	- 05	<del>10</del> 0
April		Indicator	Reading	6464	5162	4592	5434	4757	4541	5614	4610	5185	4	7270	0489	6669	7342	6422	5876	0919	5854	7051	7155	6390	5382	04/69	0909	6262	6197	6873	c 495
Incr-Decreasing	.5	Strain	Increment x106	214	224	13	- 34	191	86	- 25	242	137	•	- 35	- 33	9	8	- 42	56	205	221	994	924-	1467	-489	488	984-	784	064-	087	-464
Load Incr	4392	Indicator	Reading	5377	5614	4561	5370	5143	6464	2560	7007	2460	1	7207	6777	2269	2340	6340	5989	6572	6298	7993	6200	7332	4389	7920	5084	7232	5212	7838	5500
e Bending	10	Strain	Increment x106	214	229	- 15	- 30	196	103	- 27	11.3	151		- 26	- 28	2	N	- 37	26	202	221	424	924-	473	-492	764	-488	488	-491	483	-497
7/16" Pure	21910	tor	50	5163	5390	4554	5404	4952	4745	5585	4743	5323	,	7242	6810	6983	7345	6382	5933	6367	2209	7527	9299	6865	4888	7432	5570	6750	5702	7358	5994
Breadth = 7	0	Indicator	Reading	6464	5161	4589	5434	4756	4545	5612	0.83	5183		7268	6838	0669	7340	6419	5877	6160	5856	7053	7152	6392	5380	0469	6058	6262	6193	6875	1649
Ring		Gage	No.	٦	23	m	7	2	9	E~ (	∞ σ	10	H	12	13	14	15	16	17	18	1.9	20	21	22	23	73	25	56	27	82 5	59
Stiffening	Load	Gage	Factor	1,80			>						.82		-	>	-					1.76	_		-			٠			

Table X. Original Data



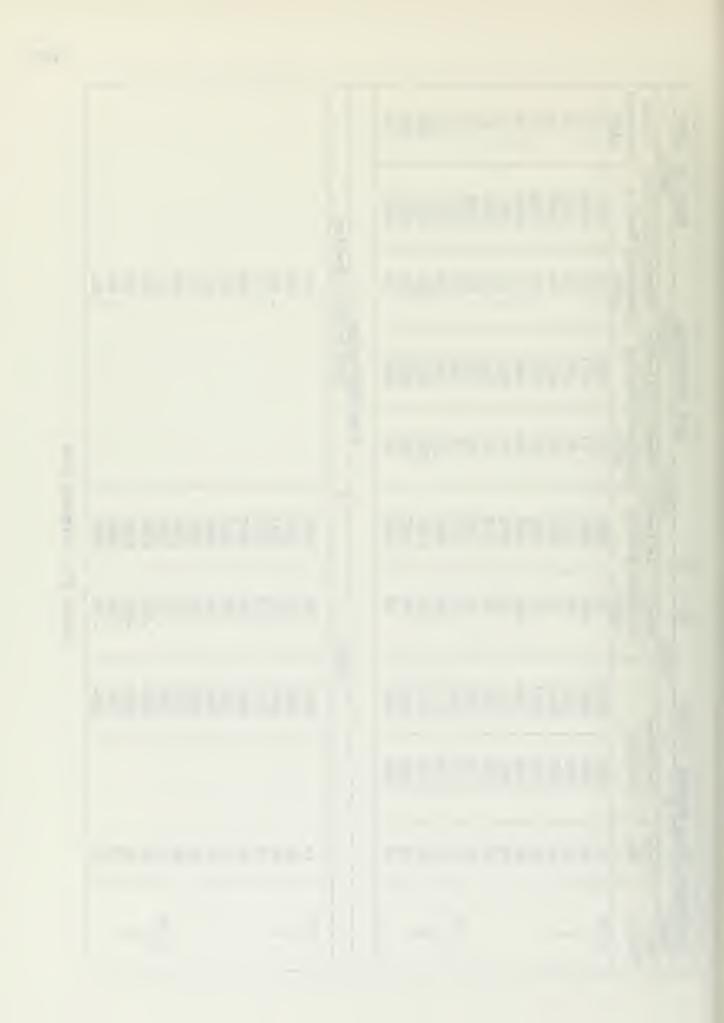
Mag	Stiffening	Ring	Breadth =	7/16"	76 = .2		Load	Increasing	გე	April 25,	, 1950
No.   Gage   Indicator   Strain   Increment   Reading   Increment   Reading   Increment   Reading   Increment   Reading   Increment   Reading   Increment   Incr	đ		0	900	0	1802	0	2700	00	3795	00
14   69644   4927   4928   493   4938   493   4937   4927   4928   493   4938	. 8	Gage No.	Indicat Reading	or	Strain Increment		Strain Increment	Indicator	Strain	Indicator	Strain
1.4   6964   6949					901x		×106	)	301x	)	×106
2.4         4997         4927         - 70         4878         - 49         4828         - 50           4.4         5829         6528         653         663         665         6620         65         65         66 <td< td=""><td>2</td><td>77</td><td>4969</td><td>6469</td><td>- 21</td><td>0069</td><td></td><td>6855</td><td>- 45</td><td>6803</td><td>- 52</td></td<>	2	77	4969	6469	- 21	0069		6855	- 45	6803	- 52
14		42	2664	4927	- 70	8284	64 -	4828	- 50	9924	- 62
144   5969   6028   59   6078   50   6125   47     54		34	5829	5892	63	5957	65	6020	63	8609	78
54   6742   6696   - 46   6632   - 64   6567   - 65     5204   5127   - 77   5066   - 61   5008   - 58     5204   5127   - 77   5066   - 61   5008   - 58     84   5370   5440   - 28   5510   - 65   5580   - 65     94   5774   5690   - 24   5633   - 57   5580   - 53     15   7505   7516   11   7529   13   7542   13     16   6010   6567   167   6498   200   6698   137     18   6400   6567   167   6498   200   6655   18     19   6010   6567   167   6734   167   6900   166     14   6020   119   5907   100     54   6031   141   6750   00     54   6531   141   6750   00     54   5510   154   5720   00     55   7519   - 38   7503   - 01     16   6847   - 305   6396   - 60     17   6500   154   6575   - 65     18   6600   135   6602   00     19   6500   135   6602   00     10   6500   135   6098   - 01     11   6500   - 24   6596   - 64     12   7519   - 38   7503   - 01     13   6500   - 431   6098   - 02     14   6556   - 346   6396   - 02     15   6500   - 157   6008   - 02     15   6500   - 157   6008   - 02     15   6500   - 157   6008   - 02     15   6500   - 157   6008   - 02     16   6500   - 157   6008   - 02     17   6500   - 157   6008   - 02     18   6500   - 157   6008   - 02     19   6500   - 157   6008   - 02     10   6500   - 157   6008   - 02     10   6500   - 157   6008   - 02     10   6500   - 157   6008   - 02     10   6500   - 157   6008   - 02     10   6500   - 157   6008   - 02     10   7510   - 157   6008   - 02     10   7510   - 157   6008   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     10   7510   - 157   - 02     1		4A	5969	6028	59	6078	50	6125	247	6188	63
64   5204   5127   - 77   5066   - 61   5008   - 58     74   5595   6567   - 28   6502   - 65   6440   - 62     75   5370   5440   - 24   5633   - 57   5580   - 58     75   75   75   75   11   75   13   75   75     75   75   75   75   11   75   13   75   75     75   75   75   75   75		5A	6742	9699	- 1	6632	<del>1</del> 9 -	6567	- 65	0649	- 22
7.4   6595   6567   - 28   6502   - 65   64440   - 62     8.4   5370   54440   70   5510   70   5580   70     1.5   7505   7516   111   7529   13   7542   13     1.5   6575   6715   140   6851   136   6598   137     1.5   6500   6567   167   6734   167   6598   136     1.5   6400   6567   167   6734   167   6590   166     1.5   6400   6567   167   6734   167   6590   166     1.5   6010   6090   97   6970   10     1.5   6500   135   6502   135   6502   135     1.5   6500   135   6502   135   6502     1.5   6500   135   6502   135   6502     1.5   6500   1		<b>6A</b>	5204	5127		9905	- 61	5008	- 58	4932	- 76
SA   5370   5440   70   5510   70   5580   70     15   7505   7516   11   7529   13   7542   13     16   6575   6715   140   6498   200   6697   197     17   6101   6298   197   6498   200   6697   199     18   6400   6567   167   6734   167   6900   168     19   6400   6090   97   6734   167   6900   168     14   6000   97   6970   70   70     14   6002   119   5007   10     15   6500   135   6602   119   5720   010     15   6500   135   6602   121   5720   010     16   6847   -305   6537   -431   6098   121   5750     18   6756   -346   6530   -157   6098   -020     19   6500   -157   6008   -020     19   6500   -157   6008   -020     19   6500   -157   6008   -020     19   6500   -157   6008   -020     19   6200   -157   6008   -020     19   6200   -157   6008   -020     19   6200   -157   6008   -020     19   6200   -157   6008   -020     19   6200   -157   6008   -020     19   6200   -157   6008   -020     10   6200   -157   6008   -020     10   6200   -157   -		7A	6595	6567		6502	- 65	0449	- 62	6365	- 75
15   5714   5690   - 24   5633   - 57   5580   - 53   15   7542   13   7542   13   13   7542   13   13   13   13   13   13   13   1		₩	5370	5440	20	5510	2	5580	20	5664	48
15   7505   7516   11   7529   13   7542   15   15   15   15   15   15   15   1	,	9A	5714	9699	- 24	5633	- 57	5580	- 53	5512	- 68
16   6575   6715   140   6851   136   6988   137     18   6400   6567   167   6498   200   6697   199     18   6400   6567   167   6734   167   6690   156     19   6010   6090   80   6173   83   6255   199     14   6900   97   6970   From Original     14   6900   97   6970   From Original     15   6500   135   6502   135   6602     15   6500   135   6503     15   6500   134   6593     15   6500   134   6593     15   6500   134   6593     15   6500   134   6593     16   6507   -1431   6098     18   6507   -1431   6098     19   6500   -157   6008     19   6200   -157     10   6200   -157     10   6008     10   6008     10   6000     10	32	15	7505	7516	11	7529	13	7542	13	7557	15
17   6101   6298   197   6498   200   6697   199     18   6400   6567   167   6734   167   6900   166     19   6010   6090   80   6173   83   6255   82     24   6900   97   6970   From Original     24   6885   119   5007   5007     25   6072   145   5828   100     54   6631   141   6750   01     55   6502   135   6602   6602     56   6847   -38   7503   -02     16   6847   -38   6596   -04     18   6756   -346   6396   -04     19   6200   -157   6008   -02     19   6200   -157   6008   -02     19   6200   -157   6008   -02     10   6200   -157   6200   -02     10   6200   -157   6200   -02     10   6200   -157   6200   -02     10   6200   -157   6200   -02     10   6200   -157   6200   -02     10   6200   -157   6200   -02     10   6200   -157   6200   -02     10   6200   -157   6200   -02     10   6200   -157   6200   -02     10   6200   -157   6200   -02     10   6200   -157   6200   -02     10   6200   -15		16	6575	6715	140	6851	136	6988	137	7152	164
18   6400   6567   167   6734   167   6900   168   199   6010   6090   80   6173   83   6255   82   82   82   82   82   82   82		17	6101	6298	197	8649	200	2699	199	6938	247
19   6010   6090   80   6173   83   6255   82     14		18	0049	6567	167	6734	167	0069	166	7102	202
14   6900   97   6970   10   From Original   14   6900   97   6970   10   10   10   10   10   10   10		19	6010	0609	80	6173	83	6255	82	6357	102
17940   0   From Original   18   6900   97   6970   06   10   10   10   10   10   10   1							Load	Decreasing	80		
1.4       6900       97       6970         2.4       4885       119       5007         3.4       5953       -145       5828         4.4       6072       -116       5970         5.4       6072       -116       5970         5.4       6072       -116       5970         6.4       5072       140       5216         6.4       5072       140       5216         6.5       154       5370       520         1.5       5633       121       5720         1.5       5633       121       5720         1.5       6847       -305       6577         1.7       6507       -431       6098         1.8       6200       -157       6008         1.9       6200       -157       6008				1794	9	0		From Ori	ginal	Reading	
24 4885 119 5007 5828 6072 -145 5828 5828 6631 141 6750 6631 141 6750 6602 740 5216 5500 135 6602 154 5720 154 5720 154 5720 154 5720 157 6698 6507 -431 6698 6500 157 6500 -157 6008	2	1.4		0069	26	0269			90		
3A     5953     -145     5828       4A     6072     -116     5970       5A     6631     141     6750       6A     5072     140     5216       7A     6500     135     6602       8A     5510     154     5370       9A     5633     121     5720       15     7519     - 38     7503       16     6847     -305     6577       18     6207     -431     6098       19     6200     -157     6008		2A		4885	119	5005			10		
4A       6072       -116       5970         5A       6631       141       6750         6A       5072       140       5216         7A       6500       135       6602         8A       5510       154       5370         9A       5633       121       5720         15       7519       - 38       7503         16       6847       -305       6577         18       6756       -346       6396         19       6200       -157       6008		34		5953	-145	5828					
5A     6631     141     6750       6A     5072     140     5216       7A     6500     135     6602       8A     5510     154     5370       9A     5633     121     5720       15     7519     - 38     7503       16     6847     -305     6577       17     6507     -431     6098       18     6200     -157     6008		4A		6072	-116	5970			01		
6A 5072 140 5216 7A 6500 135 6602 8A 5510 154 5370 9A 5633 121 5720 15 6847 -38 7503 17 6507 -431 6098 18 6756 -346 6396 19 6200 -157 6008		5A		6631	141	6750			90		
74 6500 135 6602 84 5510 154 5370 94 5633 121 5720 15 7519 - 38 7503 16 6847 -305 6577 17 6507 -431 6098 18 6756 -346 6396 19 6200 -157 6008		<b>6A</b>		5072	140	5216			12		
84 5510 154 5370 94 5633 121 5720 15 7519 - 38 7503 16 6847 -305 6577 17 6507 -431 6098 18 6756 -346 6396 19 6200 -157 6008		7A		6500	135	2099			20		
94 5633 121 5720 15 7519 - 38 7503 16 6847 -305 6577 17 6507 -431 6098 18 6756 -346 6396 19 6200 -157 6008		8 <b>A</b>		5510	154	5370			00		
15     7519     - 38     7503       16     6847     -305     6577       17     6507     -431     6098       18     6756     -346     6396       19     6200     -157     6008		9A		5633	121	5720			90		
6847 -305 6577 6507 -431 6098 6756 -346 6396 - 6200 -157 6008	22	15		7519	- 38	7503			- 02		
6507 -431 6098 6756 -346 6396 -157 6008		16		2489	-305	6577			02		
6756 –346 6396 – 6200 –157 6008		17		6507	-431	8609					
		16		6756	1.57	6396					

Table XI. Original Data



	<del></del>		_																-													_
25, 1950	Strain	Increment x106	- 59	1 27	18	65	06 -	- 76	- 79	85	- 68	20	183	239	167	57																
April 25	Indicator	Reading	6767	4708	6162	6240	6420	6984	6334	5698	2488	7580	7310	7052	2057	6223		Reading														
300	Strain	Increment x106	- 58	63	85	179	- 85	- 75	- 78	83	- 68	22	184	236	160	50	, h	ginal		00 0		5 8	300	3 O	85		ا ا ا ا	9,5	50	00	†0 -	70
Increasing 27030	Indicator	Reading	6826	4771	809	6175	6510	4945	6413	5613	5556	2560	7127	6813	6890	9919	Decreasing	From Ori														
Load	Strain	Increment x106	- 59	63	8,	62	88	776 -	- 79	81	69 -	22	181	236	161	50	Load															
35 18050	Indicator	Reading	4889	4834	5993	6111	6595	5020	6491	5530	5624	7538	6469	6577	6730	9119		0		6970	7007 6822	5060	2300	6163	757 660th	4362	2200	2504	6580	6100	6393	2000
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	Strain	Increment	- 27	-104	82	62	99 -	-115	- 33	29	- 27	13	182	241	172	58		00		120	1,74 1,72	70.		155	7.7.	200	756	33	-370	894-	(4)	- 71
7/16"		50	5469	4897	5910	6409	6883	5094	6570	5449	5693	7516	6762	6341	6969	9909		18000		6887	4040	2302	2000	2000	0679	0000	2,020	7537	1000	6584	1429	7610
Breadth = 7	Indicator	Reading	0269	5001	5828	5970	6429	5209	6603	5370	5720	2503	6580	0019	6397	8009																
Stiffening Ring I	Gage	No.	1A	2A	34	44	5 <b>A</b>	<b>84</b>	7A	8 <b>A</b>	<b>8</b> 6	15	16	17	8	57				A C	4 6	4 4	d <	4 4	46	- α	¥ 6	יר '	191	17	18	77
Stiffen	Gage	Factor	1.77	,		-						1.82		-	•				1	1.77	>							1 82				

Table XI. Original Data

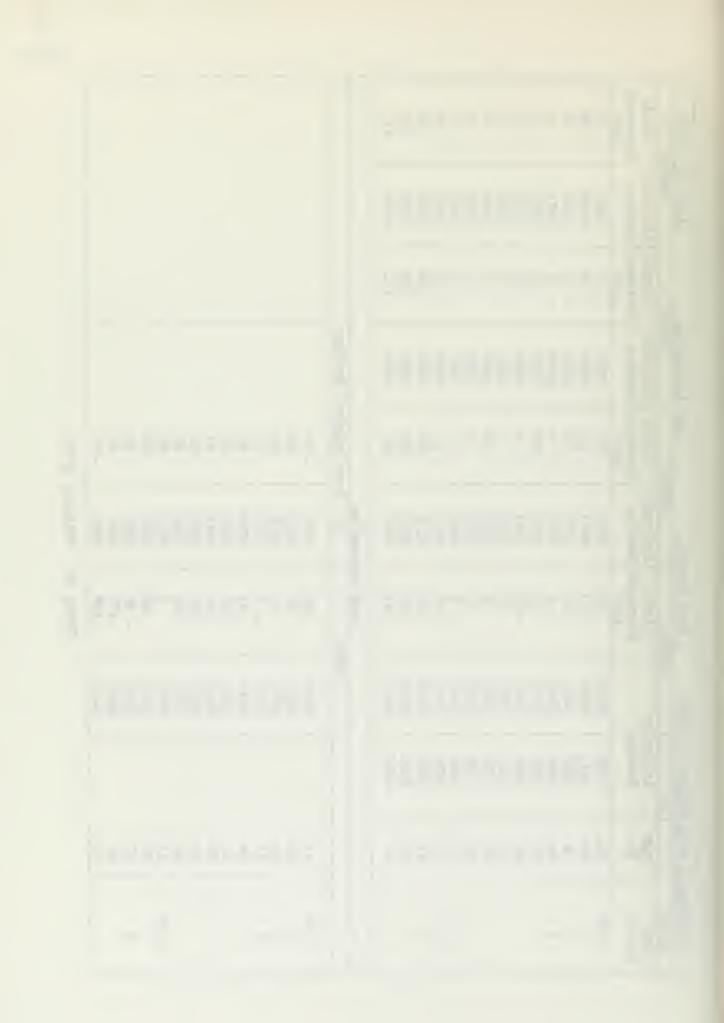


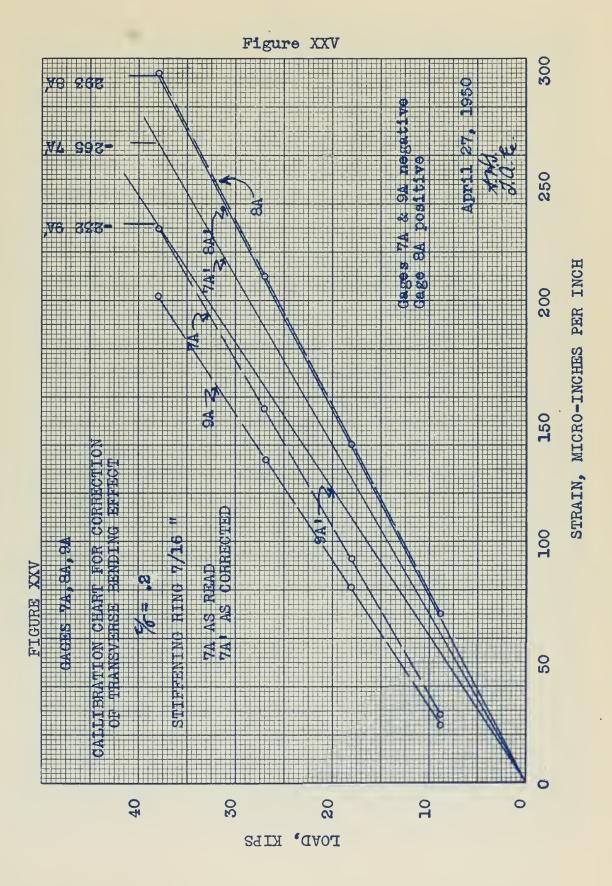
National Color	Stiffening	Ring	Breadth =	7/16"	11	2	Load	Increasing	\$n	April 25	, 1950
March   Marc	Load			06	20	181	30	2704	40	1946	5
Mo.	Gage	Gage	Indicat	tor	Strain	Indicator	Strain		Strain	Indicator	Strain
14   5970   6940   - 30   6870   - 70   6802   - 68   6745   - 68   6745   - 68   6745   - 68   6745   - 68   6745   - 68   610   - 63   6100   - 63   - 63   6100   - 63   - 63   6100   - 63   - 6	Factor	No	Reading	50	Increment x106	Reading	Increment x106		Increment x106	Reading	Increment x106
34   5000   4883   -117   4813   -70   4750   -63   4690   -63   4690   -63   4690   -63   4690   -63   4690   -63   4690   -63   4690   -63   4690   -63   4690   -63   4690   -63   4690   -64   5966   6052   -75   6072   -101   6464   -108   6380   -84   6312   -36   6474   -91   6390   -84   6312   -36   6474   -91   6390   -84   6312   -36   6474   -91   6390   -84   6312   -36   6474   -91   6390   -84   6312   -36   6474   -91   6390   -84   6312   -36   6474   -91   6470   -36   -36   6470   -36   -36   6470   -36   -36   6470   -36		1.4	0269	0469	- 30		25 =		89 -	6745	- 57
1		42	2000	4883	-117	4813		4750		0694	
14	- T-	34	5826	5920	176	6017	97	6110	93	6198	88
SA   6748   6672   -75   6572   -101   6464   -108   6383   -101   6464   -108   6383   -101   6464   -108   6383   -101   6464   -108   6383   -101   6464   -108   6383   -101   6464   -108   6383   -101   6464   -108   6383   -101   6464   -108   6383   -101   6464   -108   6383   -101   6464   -108   6383   -104   6474   -108   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   6483   -104   -10		ItA	5969	6053	178	6123	20	6198	25	6260	62
1.5   1.5		5A	84769	6673	- 75	6572	-101	4949	108	6383	- 81
7.4   6601   6565   - 36   6474   - 91   6390   - 84   6312   - 84   6312   - 84   6312   - 84   6312   - 84   6312   - 84   6312   - 84   6312   - 84   6312   - 84   6312   - 84   6312   - 84   6312   - 74   6480   - 74   6480   - 74   6480   - 74   6480   - 74   6480   - 74   6480   - 74   6480   - 74   6480   - 74   6480   - 74   6480   - 74   6480   - 74   6480   - 74   6480   - 64   6480   - 64   -		6A	5208	5081	_127	2000		4916	18 -	4845	- 71
Sa		7.4	1099	6565	- 36	472419		6390		6312	- 78
15   7502   7519   17   7542   23   7570   28   7593   17   7542   12   7570   28   7593   17   7542   12   7570   28   7593   1500		84	5370	5458	88	5547	89	5638	16	5715	22
.82 15 7502 7519 17 7542 23 7570 28 7593		9.A	5720	5690		5610	- 80	5536		5470	99 -
16   6580   6785   205   6995   210   7201   206   7386   170   6100   6567   170   6623   6880   257   7108   180   6008   6051   170   6731   164   6892   161   7033   164   6892   161   7033   164   6892   161   7033   164   6892   161   7033   164   6892   161   7033   164   6892   161   7033   164   6892   161   7033   164   6892   161   7033   164   6892   161   7033   164   6892   161   7033   164   6892   161   7033   164   6892   134   6970   00   168   5820   -06   04   164   6605   164   6605   04   6605   164   6605   -02   1	1,82	15	7502	7519	17	7542	ຊ	7570	28	7593	23
17   6100   6360   260   6623   263   6880   257   7108     18   6397   6567   170   6731   164   6892   161   7033     19   6008   6051   170   6731   164   6892   161   7033     10   6008   6051   170   6731   164   6892   161   7033     14   6879   134   6970   00   \$	_	36	6580	6785	205	6995	210	7201	506	7386	185
18   6397   6567   170   6731   164   6892   161   7033     19   6008   6051   43   6090   39   6128   38   6157     14   6879   134   6970   00     24   4821   131   5008   08     44   6118   -142   5560   -09     54   6580   197   6750   02     54   6580   158   5220   12     55   7540   -174   5367   -03     15   7540   -174   5367   -02     15   6590   -396   6578   -02     16   6693   -644   6006   -02     18   6673   -487   6006   -02     19   6693   -644   6006   -02     19   6693   -644   6006   -02     19   6693   -644   6006   -02     19   6693   -644   6006   -02     19   6693   -644   6006   -02     10   6693   -644   644   644   644     10   6693   -644   644	*	17	6100	6360	260	6623	263	6880	257	7108	228
19   6008   6051   43   6090   39   6128   38   6157     18		38	6397	6567	170	6731	197	6892	161	7033	141
18060   O From Original   18060   O From Original   18060   O From Original   18060   O From Original   1824   6970   O		13	8009	6051	43	0609	39	6128	38	6157	29
18060   0   From Original   18060   18060   0   From Original   18060   134   6970   00   6879   134   6970   00   6970   00   00   00   00   00   00   00					Load De	creasing					
1.4 6879 134 6970 2.4 4821 131 5008 2.4 4821 131 5008 3.4 6010 -188 5820 4.4 6005 5.4 6580 197 6750 6.4 5603 158 5220 7.4 5613 143 5720 1.5 5613 143 5720 1.5 6990 -396 6578 1.0 6621 -487 6100 1.1 6621 -487 6100 1.2 6093 -64 6006				180		[ ]	1 #				
2A 4821 131 5008  2A 4821 131 5008  4A 6010 -188 5820 -  6A 6580 197 6750  6A 6479 167 6605  8A 5541 -174 5367 -  15 6990 -396 6578 -  18 6621 -487 6100  19 6621 -487 6100  19 6006 -	6	0					0				
2.4 4821 131 5008 3.4 6010 -188 5820 - 4.4 6006 -396 5220 6.4 5603 158 5220 7.4 6605 6605 8.4 5541 -174 5367 - 1.5 7540 - 53 7500 - 1.5 6521 -487 6100 1.7 6621 -487 6100	7.7.	4		62.00	4.34	02.60	3				
3.4 6010 -188 5820 - 4.4 541 -142 5960 - 5.4 6580 197 6750 - 6.4 5003 158 5220 6750 - 7.4 6605 - 1.5 6590 -396 6578 - 1.5 6621 -487 6100 - 1.8 6093 - 64 6006 - 1.9 6006 -		2.A		4821	131	5008	80				
4.4       6118       -142       5960         5.4       6580       197       6750         6.4       5003       158       5220         7.4       6479       167       6605         8.4       5541       -174       5367         9.4       5613       143       5720         15       7540       - 53       7500         15       6990       -396       6578         17       6621       -487       6100         18       6732       -301       6390         19       6093       - 64       6006		34		6010	-188	5820					
5A     6580     197     6750       6A     5003     158     5220       7A     6479     167     6605       8A     5541     -174     5367     -       9A     5613     143     5720     -       15     7540     -     53     7500     -       15     6990     -396     6578     -       17     6621     -487     6100       18     6732     -301     6390       19     6093     -     64     6006	:-	44		6118	-145	5960					
6A 5003 158 5220 7A 6479 167 6605 8A 5541 -174 5367 - 9A 5613 143 5720 15 7540 - 53 7500 - 16 6990 -396 6578 - 17 6621 -487 6100 18 6732 -64 6006 -		SA		6580	197	6750	05				
7A 6479 167 6605 8A 5541 -174 5367 - 9A 5613 143 5720 15 7540 - 53 7500 - 16 6990 -396 6578 - 17 6621 -487 6100 18 6732 -301 6390 - 19 6093 - 64		<b>6A</b>		5003	158	5220	12				
8A 5541 -174 5367 - 9A 5613 143 5720 - 15 7540 - 53 7500 - 10 6990 -396 6578 - 17 6621 -487 6100 - 18 6732 -301 6390 - 19 6093 - 64		7A		62479	167	6605	70				
94 5613 143 5720 15 7540 - 53 7500 - 15 6990 - 396 6578 - 6000 17 6621 - 487 6100 6732 - 64 6006 - 6006 - 6006		8 <b>A</b>		5541	-174	5367					
15     7540     - 53     7500     -       16     6990     -396     6578     -       17     6621     -487     6100       18     6732     -301     6390     -       19     6093     - 64     6006     -		<b>86</b>		5613	143	5720	8				
6990 -396 6578 - 6621 -487 6100 6732 -301 6390 - 6093 - 64 6006 -	1.82	15		2540	- 53	2500	- 02				
6621 -487 6100 6732 -301 6390 - 6093 - 64 6006 -		10		0669	-386	6578					
6732 -301 6390 - 6093 - 64 6006 -	300	17		6621	-487	9019	00				
- 9009 - 97 - 6609		18		6732	-301	6390					
		16		6093	179 -	9009					

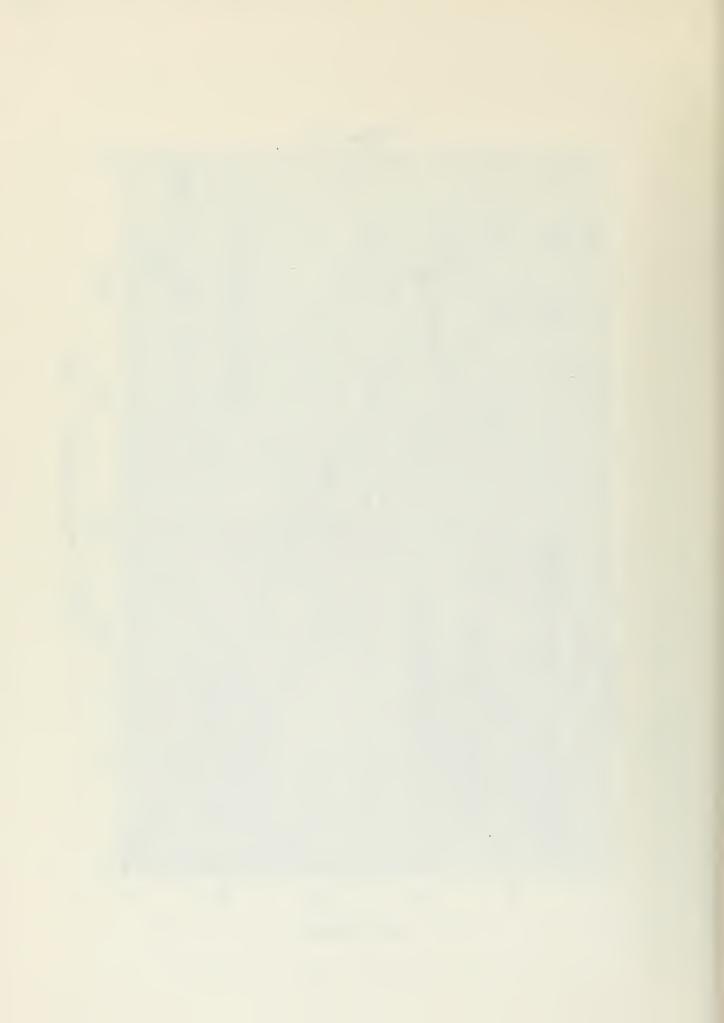
Table XI. Original Data

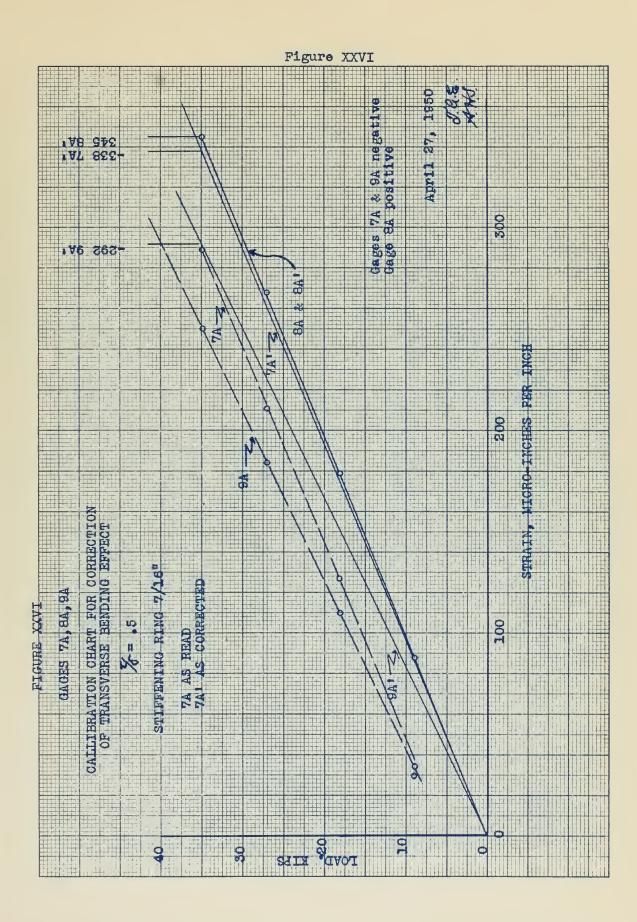
, 1950	0	Strain	Increment x106	33	- 29	- 22	~	45	- 25	20	9	139	<b>ω</b>	- 27	22	66	111																	
April 25,	000111	Indicator	Reading	7088	4928	5760	5971	6895	5155	6682	2404	5787	2425	6465	6182	0629	6452																	
5.0	50	Strain	Increment x106	25	18	- 15	6	25	13	14	ω	<b>~</b> −1	0	- 26	772	100	111																	
Increasing	33050	Indicator	Reading	7055	4957	5782	5970	6850	5180	6662	5398	5768	2483	6492	6160	1699	6341		al Reading															
Load	30	Strain	Increment x106	20	35	- 18	7	56	6	ω	10	0,	2	- 25	え	101	113		From Original	Č	50	2	050	05	- 03	01	- 01	8	- 02	8	0	- 03	170 -	†0 -
Bending	22030	Indicator	Reading	7030	4975	5797	5971	6825	5193	8499	5390	5757	2488	6518	6136	6591	6230	Decreasing		/ 50/	92.69	5013	5830	5978	6758	5223	6612	5371	5726	2495	6570	2809	6386	1009
Pure	1060	Strain	Increment x106	30	- 23	- 13	8	38	- 20	27	6	20	0	- 27	22	100	112	Load De		,	۵ ۲	24	147	٦ -	- 81	36	- 43	- 11	- 36	7	20	- 34	-172	-194
7/16"	110	tor	ħū	7010	0664	5815	5975	6629	5202	0499	5380	5748	2490	6543	6112	0649	6117		21900		20.70	4975	5801	5970	6814	5191	6639	5393	5751	2479	6515	6148	6618	6258
Breadth = 7	0	Indicator	Reading	9869	5013	5828	9265	6761	5222	6613	5371	5728	2495	6520	0609	6390	6009																	
Ring		ශිසුම	No.	1.4	24	XX.	₩7	5A	<b>6</b> A	7.4	8 <b>A</b>	<b>8</b> 6	15	16	17	18	19			0	Y T	3	34	¥47	5A	<b>6A</b>	7A	8 <b>A</b>	9A	15	16	17	18	19
Stiffening	Load	Gage	Factor	1.77			>						1,82	_	,	<b>B</b> ra				6	7.).*T		-	_						1.82		(B)		

Table XI. Original Data









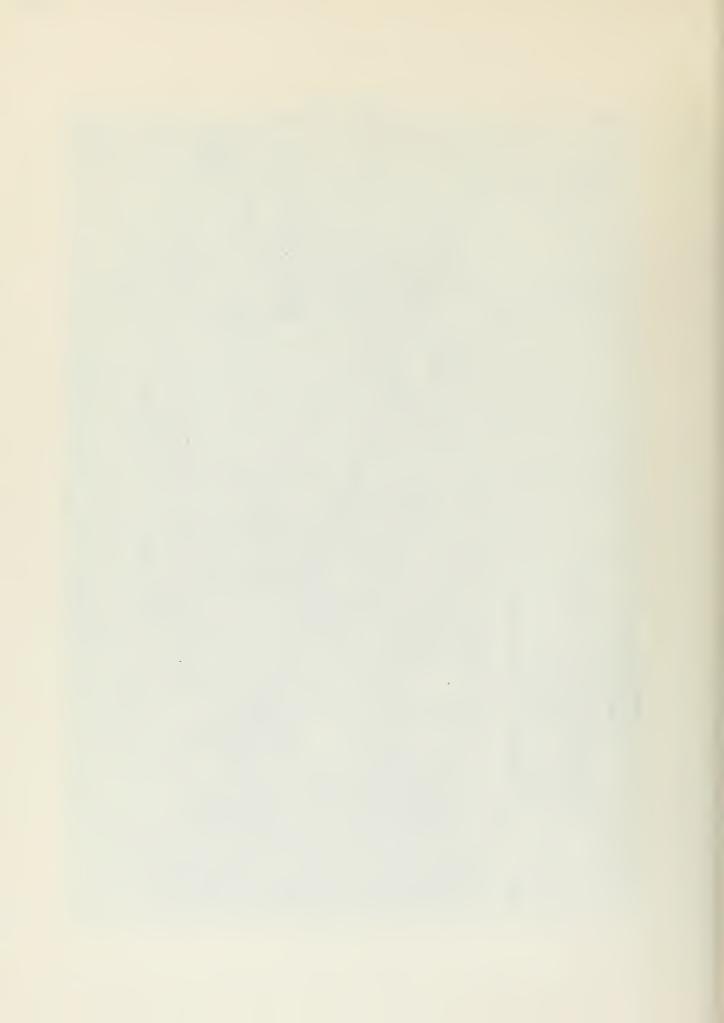
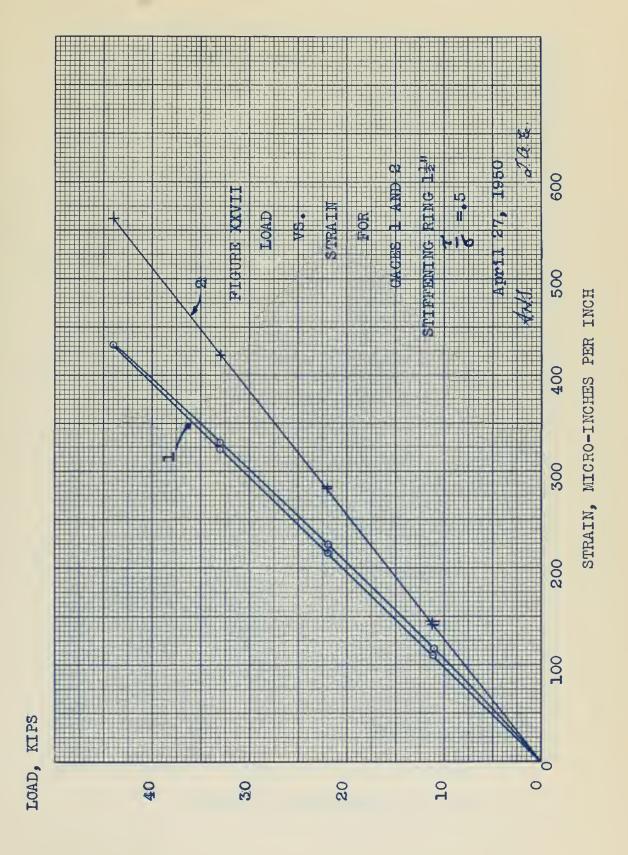
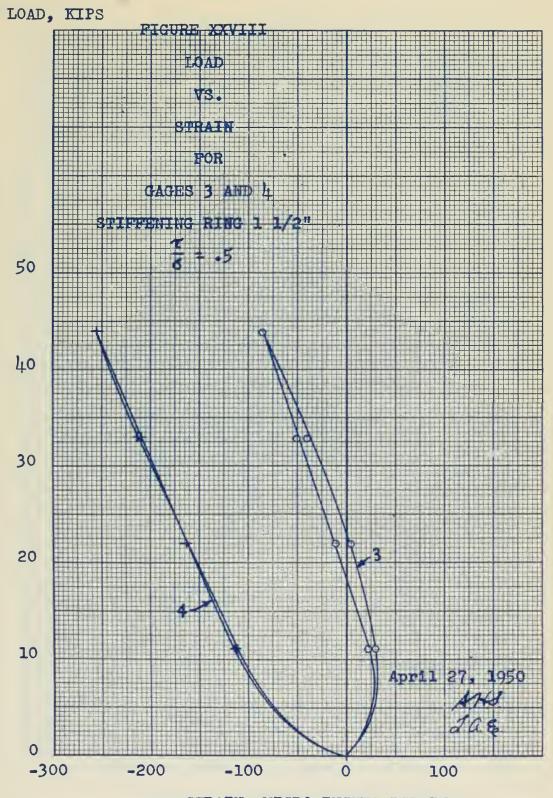


Figure XXVII





### Figure XXVIII



STRAIN, MICRO-INCHES PER INCH



Figure XXIX



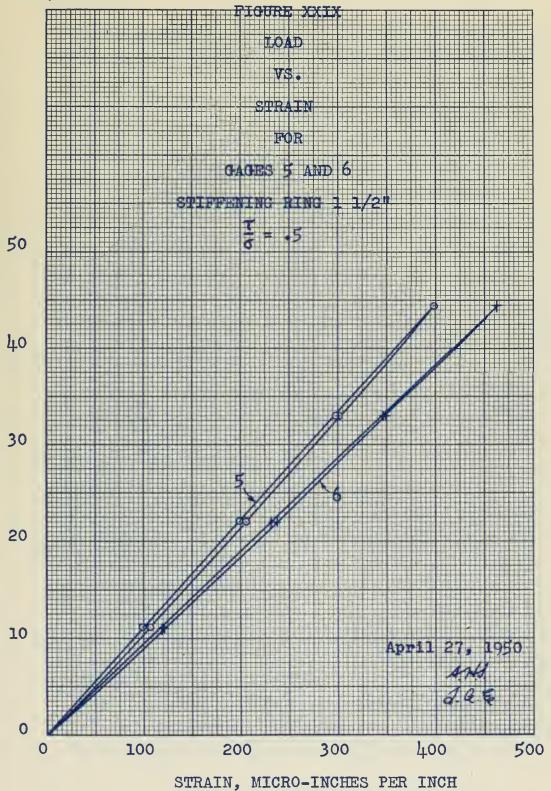
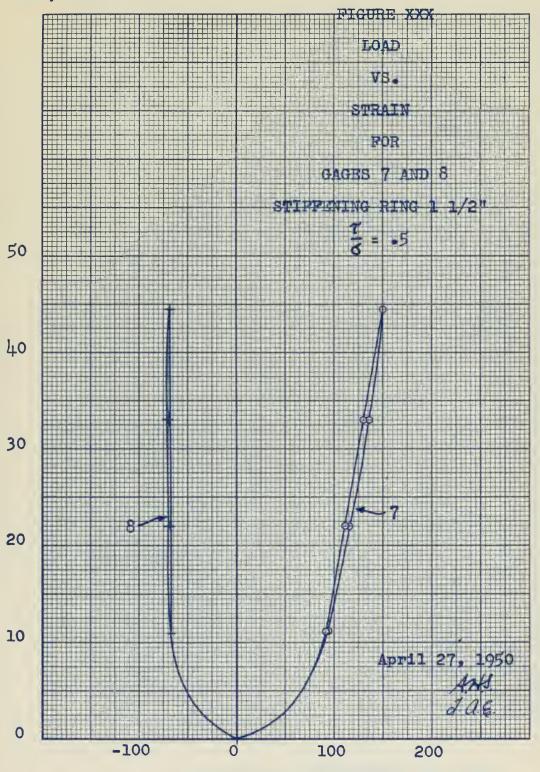




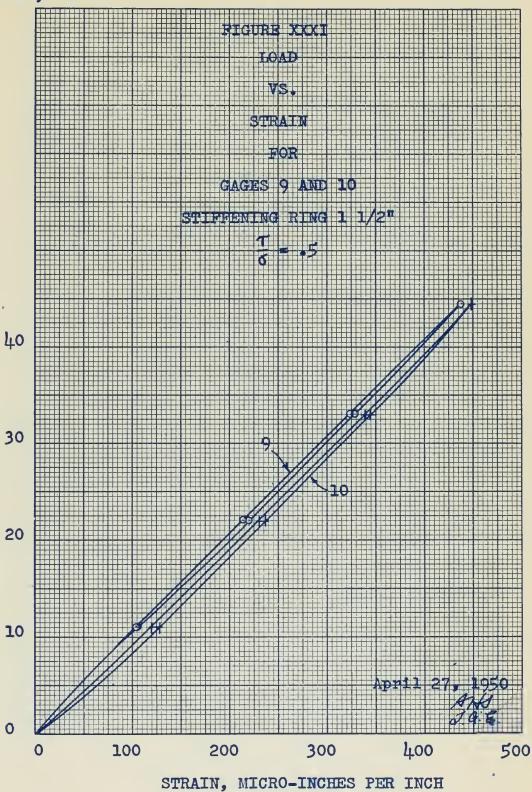
Figure XXX

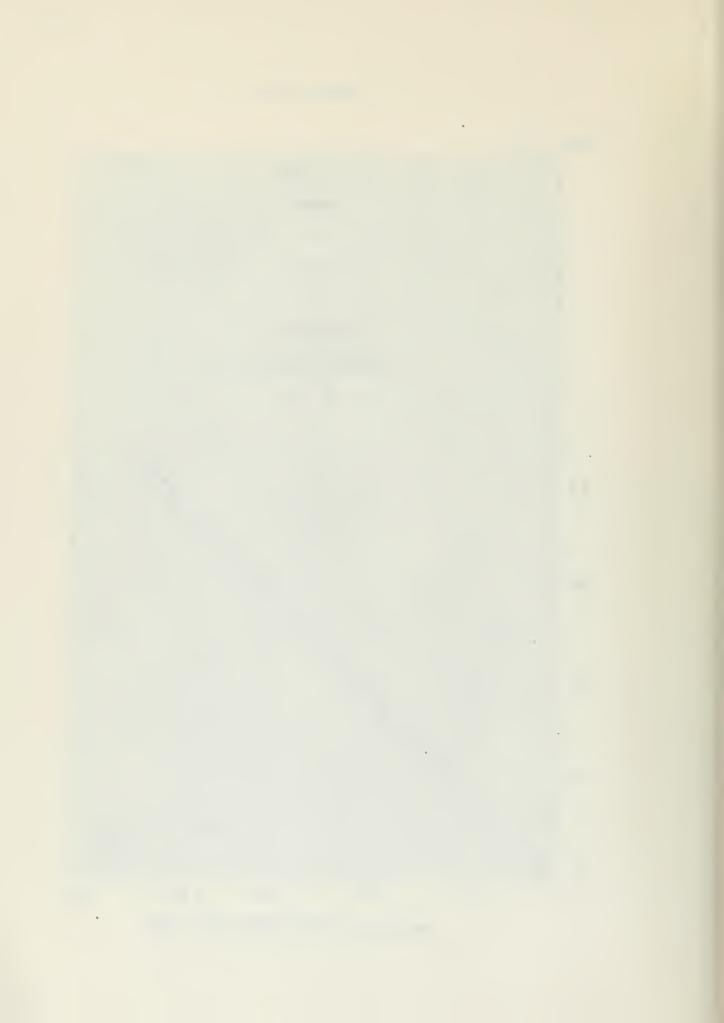


STRAIN, MICRO-INCHES PER INCH

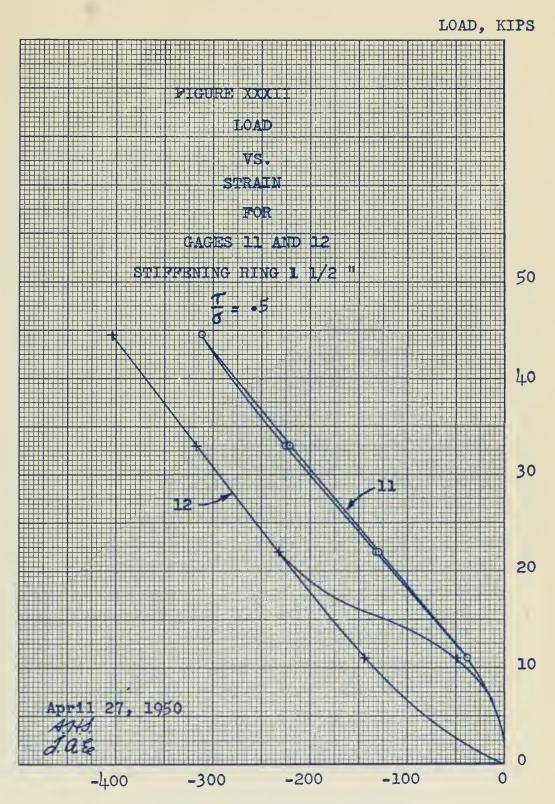


Figure XXXI





#### Figure XXXII



STRAIN, MICRO-INCHES PER INCH



Figure XXXIII

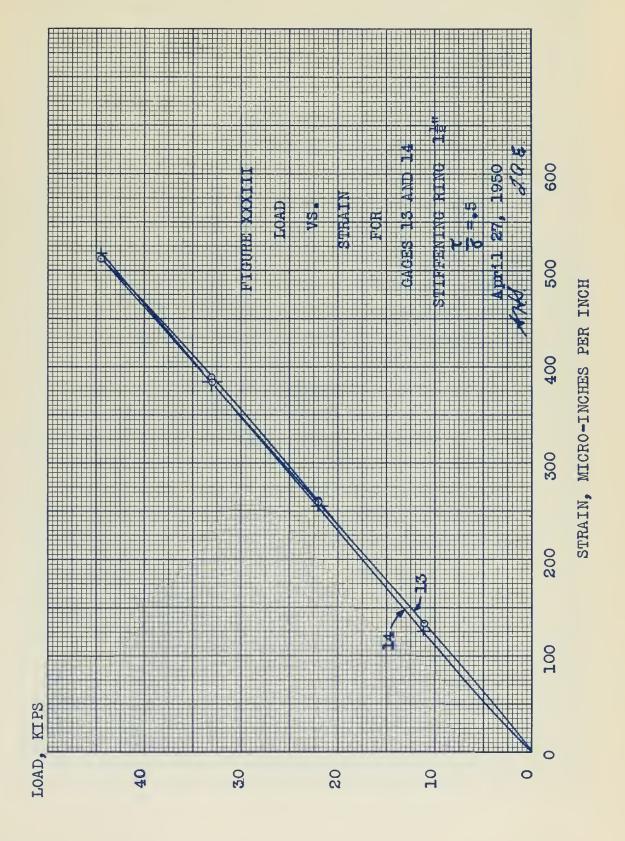




Figure XXXIV

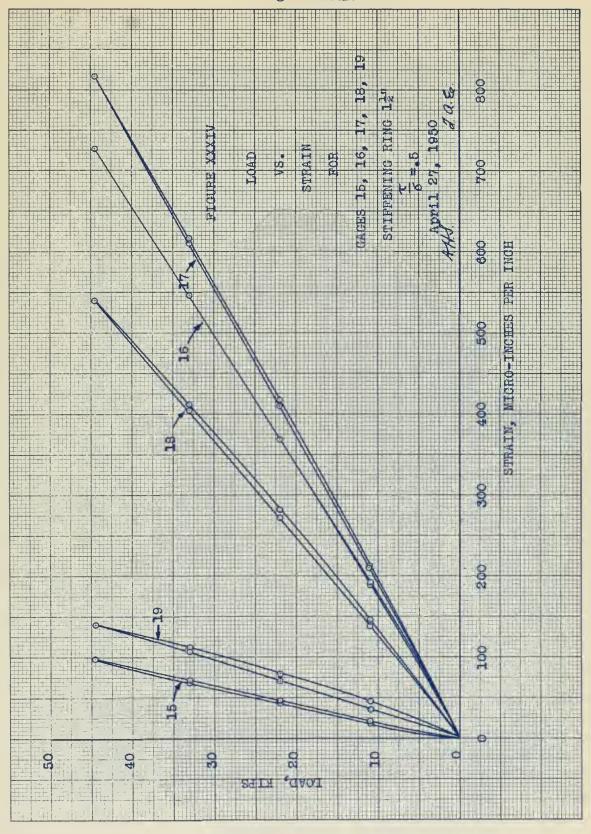




Figure XXXV

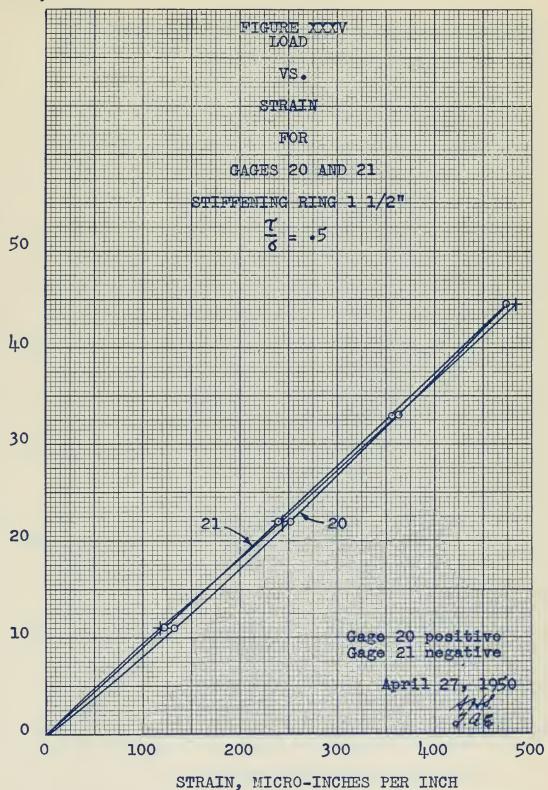




Figure XXXVI

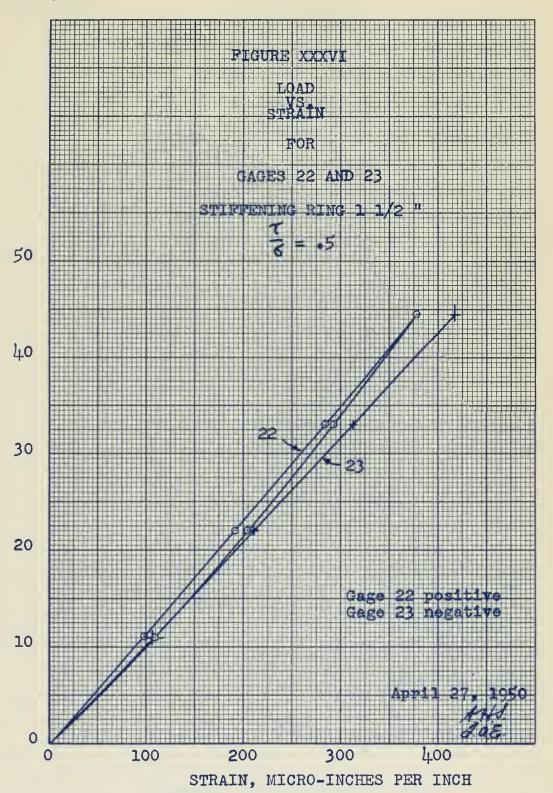




Figure XXXVII

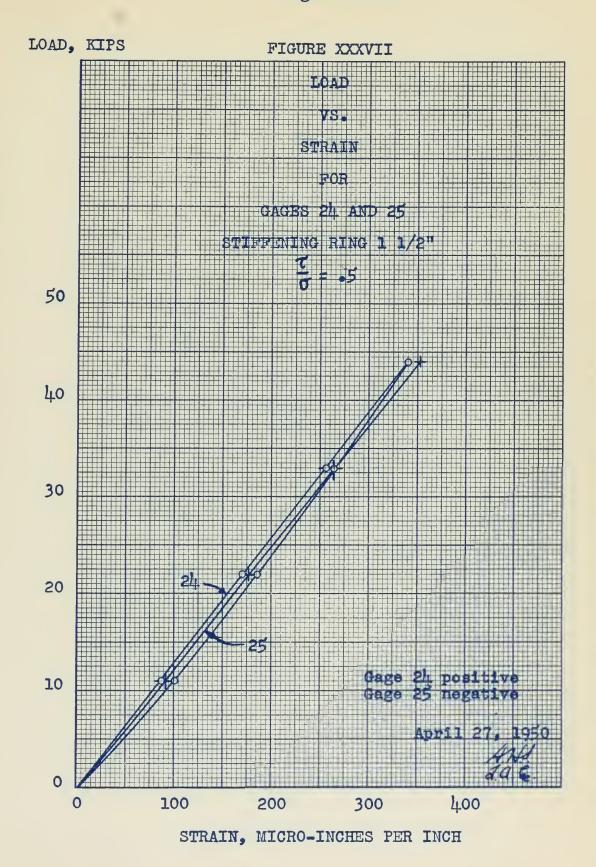
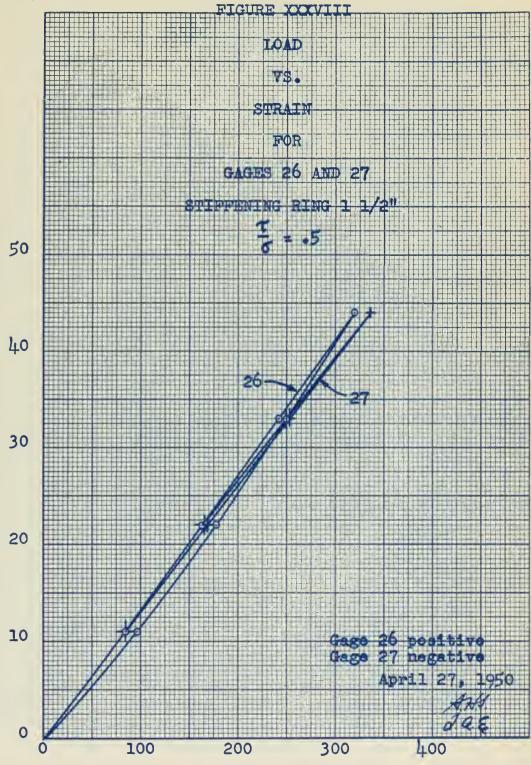




Figure XXXVIII



STRAIN, MICRO-INCHES PER INCH

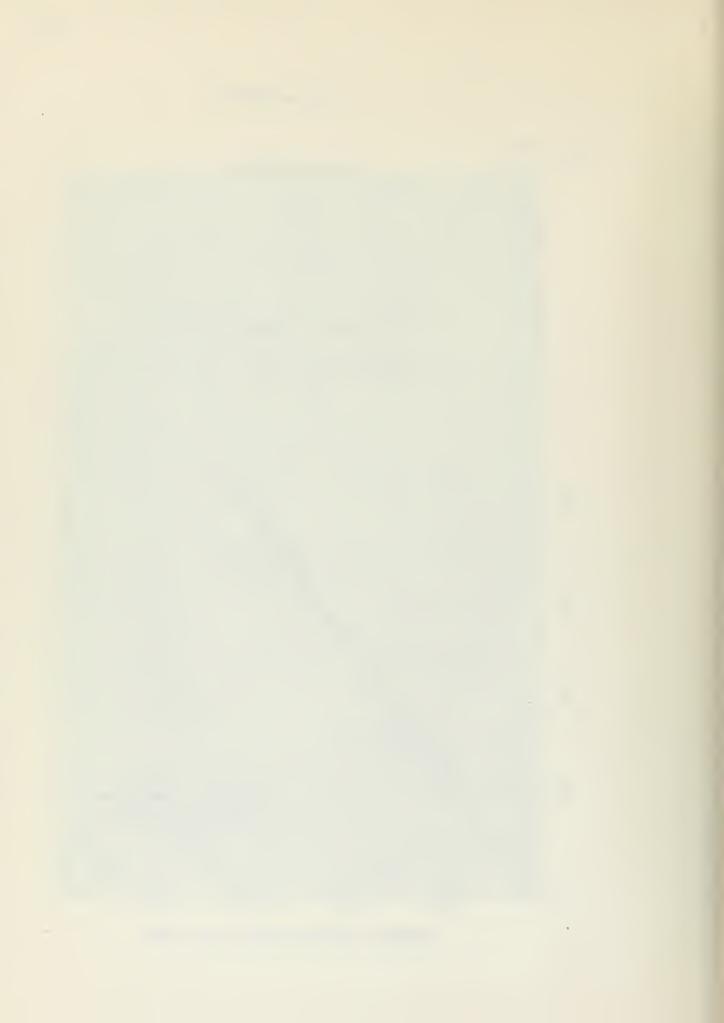
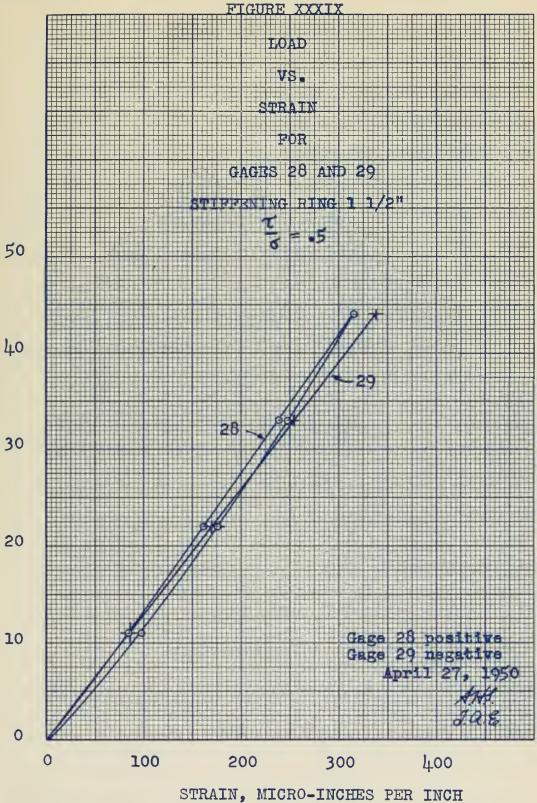
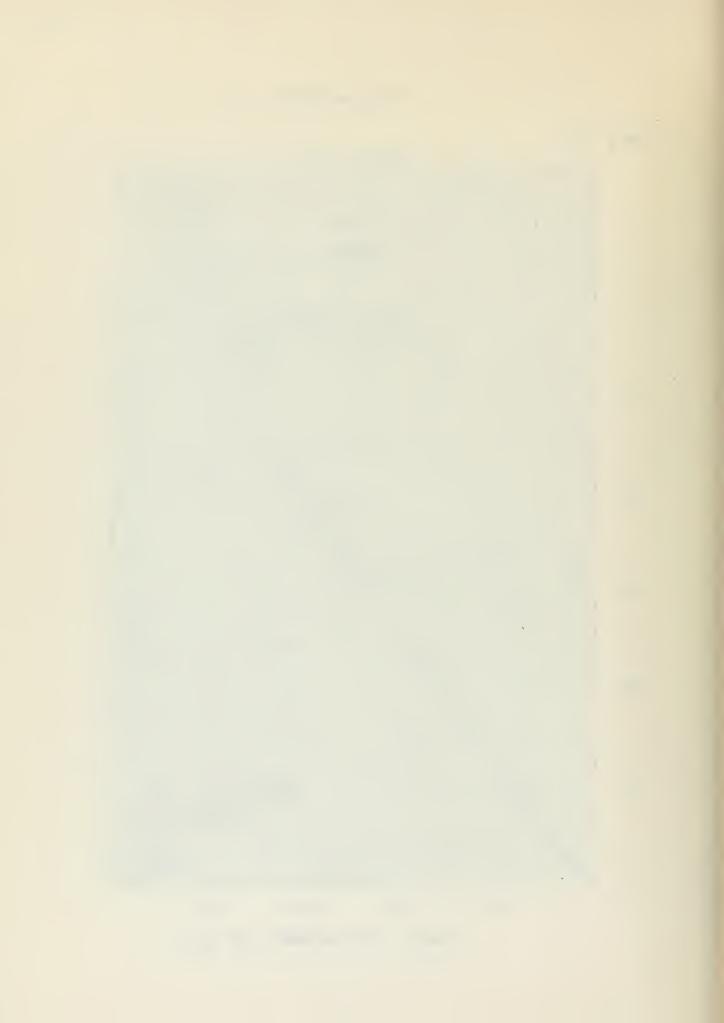


Figure XXXIX





#### TENSILE TEST OF MATURIAL

Two flat plate test specimens were prepared in accordance with the specifications of the A. S. T. N., one from an excess portion of the original beam, the other from material corresponding to that used in the flat bar stiffening ring. These were tested in a 60,000 pound Baldwin-Southwork hydraulic testing machine. Huggenburger Tensometers were attached to the specimens and readings of strain were made at each load. From the load vs. strain plot of each specimen, Figures XL and XLI, the modulus of elasticity and the approximate yield point were obtained.

The multiplication ratios for the Tensometers were as follows:

No. 69 325

No. 71 330



TABLE XIII

TENSILE TEST SPECIMEN CUT FROM

STEEL BEAM

Load, Lbs.	Huggenburger Readings		Avg. Reading	Elongation x10+3
	н - 69	H - 71		
1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 12000 14000 17000 17700 17500	.02 .05 .08 .12 .15 .175 .21 .24 .26 .30 .355 .425 .48 .52	.03 .065 .10 .125 .155 .180 .21 .24 .26 .30 .355 .415 .47 .50	.025 .0575 .090 .1225 .1525 .1775 .21 .24 .26 .30 .355 .420 .475 .51	.077 .176 .275 .375 .466 .543 .642 .735 .795 .9175 1.085 1.235 1.453 1.560 1.637
17200	1.20	1.20	1.20	3.67

Area of cross section 0.361 sq. in.

Approximate yield load 17,700 Lbs.

Approximate yield point 49,000 psi.

Modulus of Elasticity 30.3 x 10<sup>6</sup> psi.



Figure XL

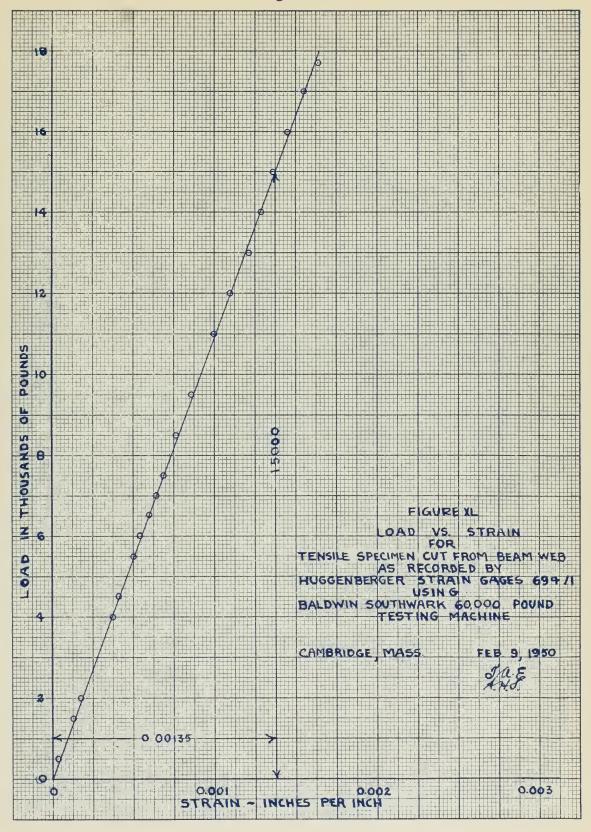




TABLE XIV

# TENSILE TEST SPECIMEN CUT FROM FLAT BAR

Huggenburger Average Elonga Readings Readings x103	
н – 69 н – 71	
10	
0307050005025 .020402 .05 .00 +.025 .07 .01 .04 .10 .045 .0725 .145 .05 .0825 .150 .08 .115 .19 .145 .167 .23 .180 .205 .275 .230 .252	0153 0076 0061 +.0076 .0122 .0222 .0252 .0352 .0512 .0670 .0772

Area of cross section .500 sq. in.

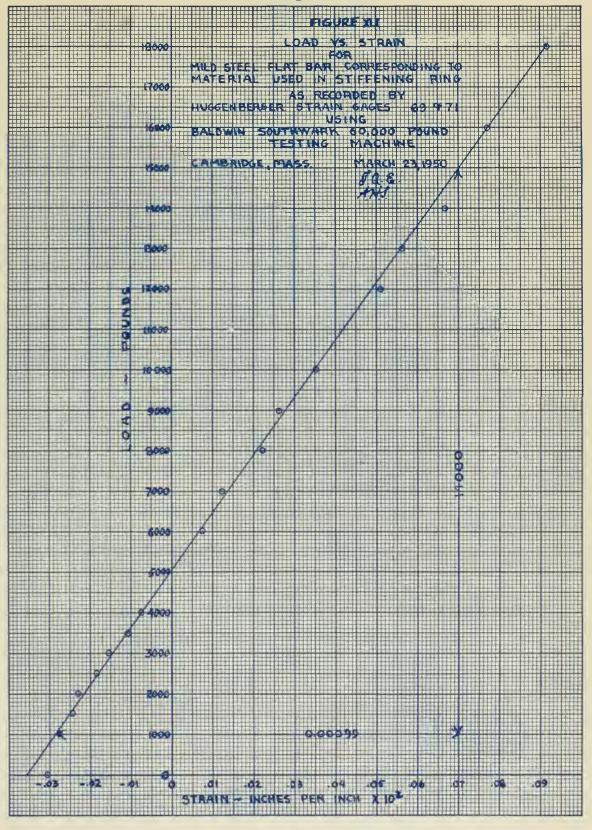
Approximate yield load 19000 Lbs.

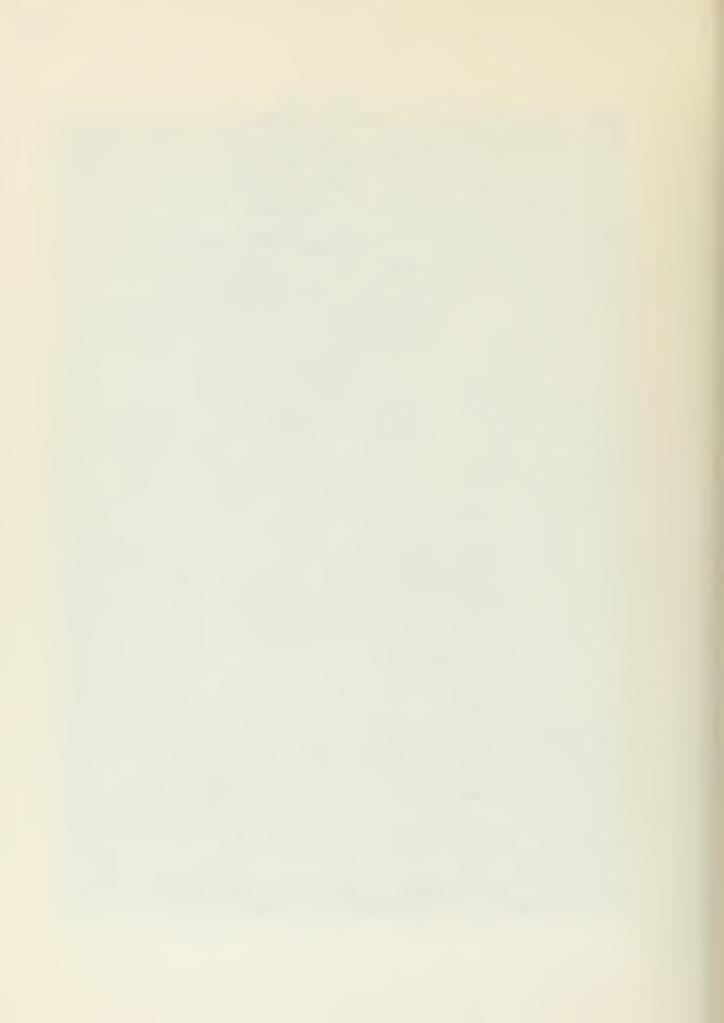
Approximate yield point 33,000 psi.

Modulus of Elasticity 29.28 x 10<sup>6</sup> psi.

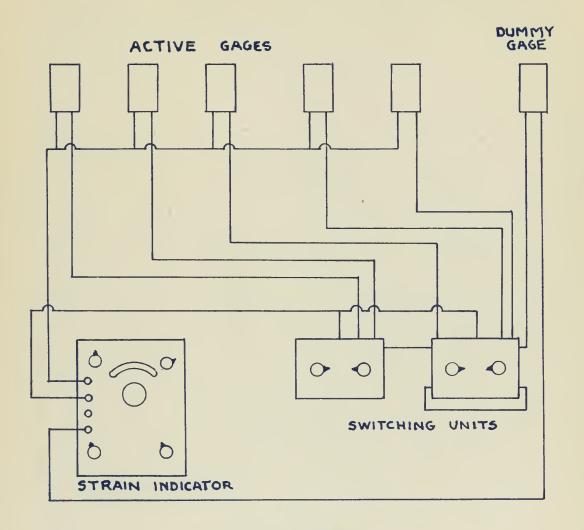


Figure XLI





## FIGURE XLII



WIRING DIAGRAM
FOR
STRAIN GAGES AND INSTRUMENTS

S. Q. E. H. H.S.

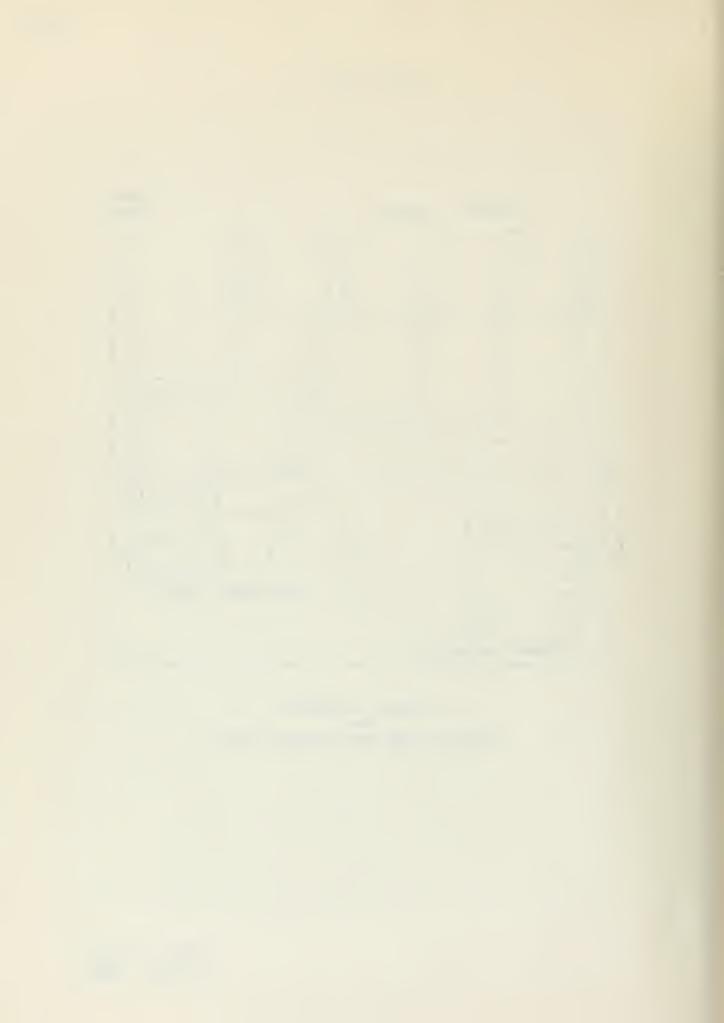
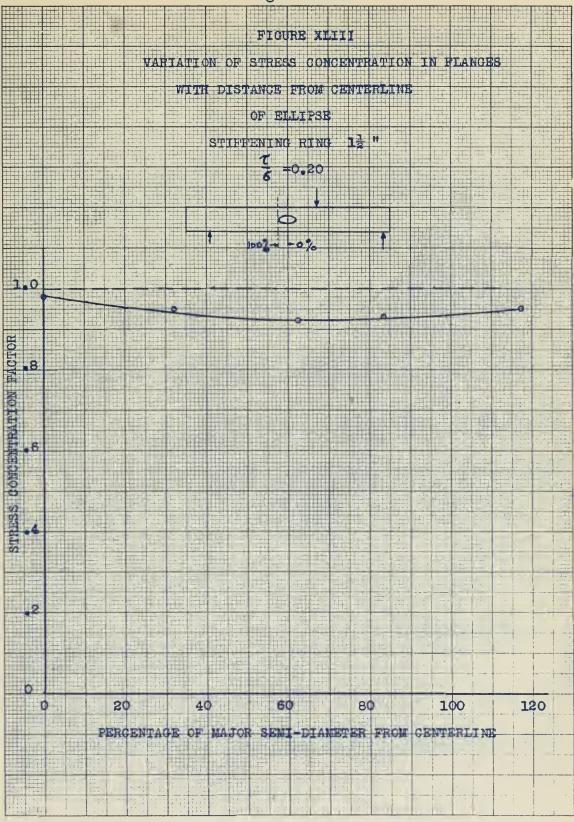
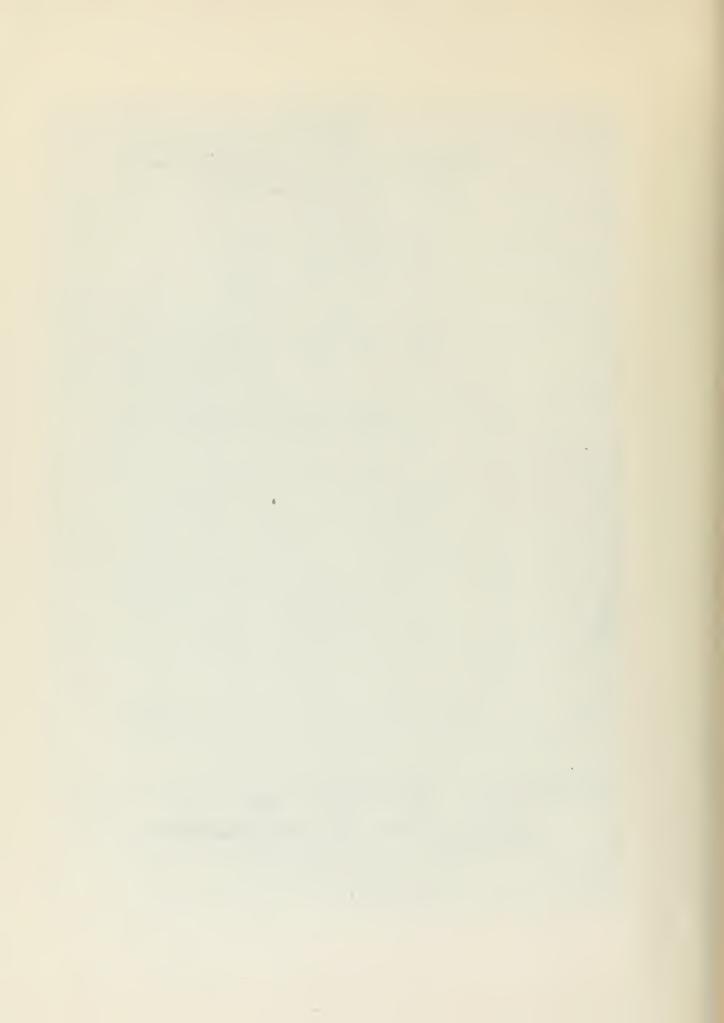


Figure XLIII



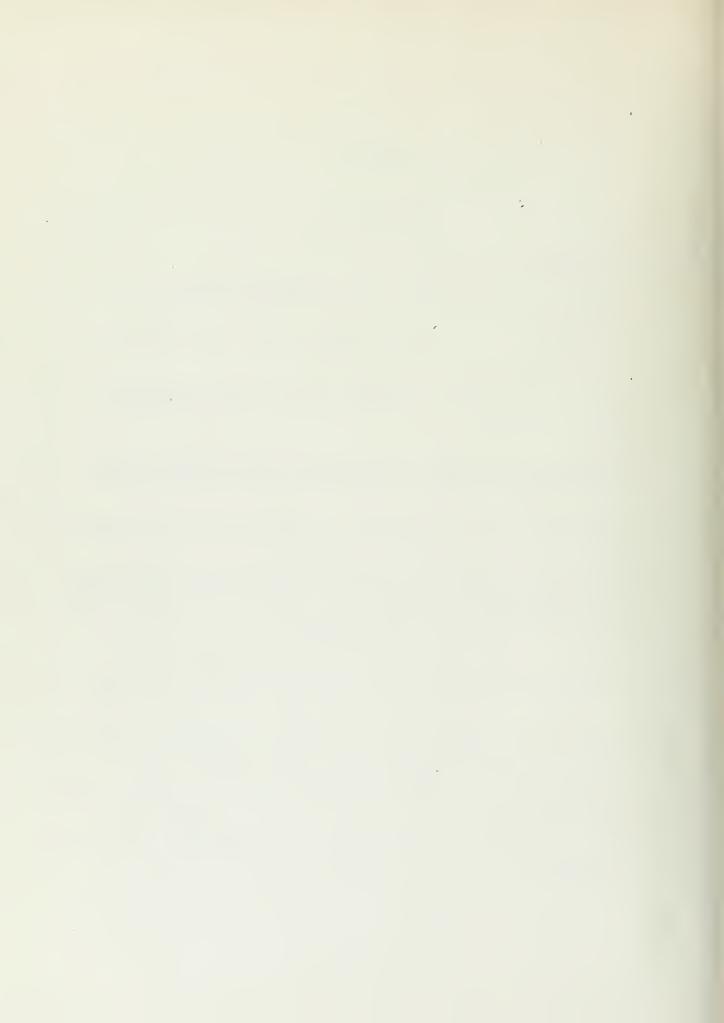


## APPENDIX E

## BIBLIOGRAPHY

- 1. Ruffner, B. F., and Schmidt, C. L., Stress at Cut-outs in Shear Resistant Webs as Determined by the Photoelastic Method, National Advisory Committee for Aeronautics, Technical Note No. 984, 1945.
- 2. Timoshenko, S., Stress Concentration Produced by Fillets and Holes, International Congress for Applied Mechanics, 1926.
- 3. Sezawa, K., and Kubo, K., <u>Stresses in Plate with Flanged Circular Hole</u>, Tokyo Imperial University Aeronautical Research Institute, Report V7, 1932.
- 4. Ryan, J. J., and Fischer, L. J., <u>Photoelastic Analysis of Stress</u>

  <u>Concentration for Beams in Pure Bending with Central Hole</u>, Journal of the Franklin Institute, 193°.
- 5. Ballinger, J. M., and Obermeyer, J. A., <u>Investigation of the Tensile Stress Distribution Around an Access Hole</u>, Master's Thesis, 1941.
- 6. Joseph, J. A., and Brock, J. S., The Stresses Around a Small Opening in a Beam Subjected to Pure Bending, Preprint of Paper No. 50-APM-3 for Presentation at the Conference of the Applied Mechanics Division, Purdue University, Lafayette, Indiana, June 22-24, 1950, of the American Society of Mechanical Engineers.
- 7. Neuber, H., <u>Theory of Notch Stresses</u>, David Taylor Model Basin, Translation No. 74 by F. A. Raven and J. S. Brock, November, 1945. (Distributed by J. W. Edwards, Ann Arbor, Michigan.)
- 8. Karl, R. L., Heller, S. R., and Gerich, W. J., <u>Influence of Small Holes on Stress Distribution of a Plate in Pure Bending</u>, Naval Engineer's Thesis, M. I. T., 1950.
- 9. Baldwin Locomotive Works, <u>Baldwin SR-4 Strain Gages for Stress Analysis</u>.
  Bulletins 279-A.
- 10. Baldwin Locomotive Works, <u>SR-4</u> <u>Strain Gages</u>, <u>Instruments and Accessories</u>, August, 1949.









DATE DUE				
			Agr-	

Thesis

E26 Efird

Stress concentration in a beam with a reinforced elliptical discontinuity.

Thesis

12869

12869

E26 Efird

> Stress concentration in a beam with a reinforced elliptical discontinuity.

thesE26
Stress concentration in a beam with a re

3 2768 001 90356 0
DUDLEY KNOX LIBRARY